


FLAK, UNLIMITED

POPULAR MECHANICS MAGAZINE

APRIL
25 CENTS
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 **BUY UNITED STATES
WAR SAVINGS
BONDS AND STAMPS**

SEE PAGE 17



Remember when... *Jim used to average 70 - and brag about it?*

SEEMS A LONG TIME, doesn't it, since Jim and chaps like him used to sit around and brag about how they made the other fellow eat their dust?

To hear them talk, a couple of hundred miles in less than a couple of hundred minutes was just ordinary going!

That sort of conversation is out of fashion now. So is that sort of driving — and for mighty good reasons.

Fast driving is plenty tough on tires — and tire wear is one of the deadliest enemies we have to face on the home front.

There's only one safe plan to follow if you own a car today: Figure that your present tires are going to have to last you for the duration (and perhaps for some time beyond) and treat them accordingly.

There may be enough replacement tires for non-military uses before the war is over. There may be synthetic tires of such quality and in such

numbers that they will offset the lack of natural rubber.

But don't count on it. If you do, you may have to lay up your car. You don't want that to happen and neither does Uncle Sam, because those of us here at home must help to fight this war with our cars as well as with our sweat and our dollars. One of the major battles we are engaged in is the Battle of Rubber. *You can help to win it!*

* * *

REMEMBER WHEN there were new tires for sale on almost every corner, and at almost any price you wanted to pay? But then, as now, it was the **INDEPENDENT** tire dealer upon whom you could most surely depend for quality and fair dealing, and for interested, personal service. We at Seiberling believe in the future of the American brand of independence and of the independent American business man. That's why Seiberling Tires always have been and will continue to be sold by **INDEPENDENT** dealers only.

SEIBERLING

Experts in Rubber



Wartime manufacturers of Bullet-Sealed Tubes and Military Tires for our armed forces • Bullet-Sealing Gasoline Tanks • Rubber Floats, Boats and Pontons • Rubber Parts for Gas Masks, Airplanes and Tanks. Also makers of Tires and Tubes for passenger cars and trucks • Sealed Air Tubes • Rubber Heels, Soles and Mechanical Goods.



MEET YOUR NEW NEIGHBOR...

Everyone knows that the world is growing smaller through the development of Science and Industry—the War is a grim reminder of this fact . . . but when the job of war is done and the Peace is won the world will become a *Neighborhood of Nations*—working and living together for their mutual betterment.

Radio will serve the world in a measure far greater than ever before—for pleasure, education, safety and convenience of all mankind!

Look to *Hallicrafters*—they are planning ahead TODAY for *your* radio TOMORROW—plans born of wartime manufacturing experience and engineering developments.

hallicrafters RADIO

THE ALL OUT EFFORT of the people of Hallicrafters has won for them the honor of being the 1st exclusive Radio manufacturer to win the Army-Navy Production Award for the 3rd time . . . FIFTY MILLION DOLLARS worth of war research and developments will be built into your next Hallicrafters Radiot



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THE HALLICTRAFTERS CO., MANUFACTURERS OF RADIO
AND ELECTRONIC EQUIPMENT, CHICAGO 16, U.S.A.

APRIL, 1944

This One



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1A



THERE ARE STILL UNDISCOVERED CONTINENTS

COLUMBUS had a definite goal—a west-bound sea route to Asia. But what he found was a new continent—a new source of Nature's wealth.

Modern research also has its goals: it, too, discovers new resources. Starting from the knowns of science, it charts its voyages into the unknown. Behind each voyage is a theory that there is a passageway.

But research doesn't hold stubbornly to its theories. If it finds islands instead of a continent, it accepts them, for it expects the unexpected. It studies their relation to the known lands of science. And on the basis of its increased knowledge, it makes revised plans for progress. In science there is always a continent ahead.

Just what research will disclose can never

be forecast. But history has proved that from research flow discoveries of value to mankind. From Bell Telephone Laboratories there has poured a full stream of improvements in the telephone art.

Bell Laboratories has kept America leading the world in telephony. And its researches have contributed importantly to other arts of communication—to the phonograph and sound-motion pictures, to radio broadcasting and television.

Today, as ever since Pearl Harbor, its efforts in research and design are devoted to the war needs of the nation.

When peace comes, its organized teams of research scientists and engineers will continue to explore and invent and perfect for the improvement of telephony.



BELL TELEPHONE SYSTEM

Popular Mechanics Magazine

Registered in U. S. Patent Office and Canada

H. H. WINDSOR, Founder

H. H. WINDSOR, Jr., Editor and Publisher

April, 1944

Vol. 81, No. 4

Next Month

THE old saying that luck is the point where opportunity and preparedness meet certainly applies to Uncle Sam's pinpoint bombardiers. It may be an exaggeration to say they can drop a bomb into a pickle barrel on the Unter den Linden—but they can come close. Despite rocket-launching fighter planes, heavy flak and blinding searchlights, the bombardier can hit the target with America's famed bombsight. This mechanical and electrical wonder coupled to an automatic flight control device actually flies a plane during the bombing run. How it works is told in a May feature, "Our Bull's-Eye Bombardiers."

Bouncing Baby

WHEN America's synthetic rubber industry hits its full stride in the near future, one huge plant alone will be turning out enough rubber to make 63,000 passenger car tires a day. A boon in wartime, this product will find hundreds of peacetime uses with its superior resistance to grease and sun. How this "Bouncing Baby With a Future" will affect postwar products is told in an outstanding article next month.

Building Blocks

IT pulled your flivver out of the mud a few years ago. Today, concrete is helping win a war by enabling war plants to mushroom up over night, and bottling rivers to produce power. After the war, it will give you a better house with soundproof bedrooms included. A May article tells how wartime know-how is making "Building Blocks for a New World."

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"The Caissons Go Rolling Along"

WHILE rocket-launching weapons and super-bombers capture the headlines, heavy field guns keep right on capturing enemy positions. The high respect with which the enemy regards Yankee field artillery was evidenced by a captured Nazi officer who asked to see our "automatic" field piece. He thought there was no other explanation for the barrage of shells that reduced a fortress to dust. An article next month takes you behind the scenes with a gun crew at the front where you will meet 15-ton "Long Tom," our new 105-mm. howitzer, and other mobile giants.

4,600,000 Trucks Go to War

RUMBLING over frozen roads on the Russian front, sloggling through jungle mud, or serving on the home front as vital carriers on a network of 1,000-mile assembly lines, are 4,600,000 U. S. trucks performing hundreds of daily tasks to help smash the Axis. One truck line delivered a cargo of life rafts from New England to a West Coast port 36 hours ahead of schedule after a dramatic race against time across the country. Read "Trucking to Victory" next month.

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SCREWBALL IDEAS ON BATTERY CARE

#1

Here's a lulu straight from the squirrel cage. Move up your idling speed to make the generator deliver maximum output. Yes, it might save you a recharge, but man, how it eats those "A" coupons up!



but.. THE WISE WAY

IS PERIODIC RECHARGES!

RESTRICTED driving is hard on batteries. Rationed mileage keeps them from getting a normal recharge from the generator, and can cause serious starting trouble unless certain precautions are taken.

Keep your battery in tip-top shape by letting an experienced Exide Dealer give it a check-up every two weeks. In many cases, periodic recharges are essential, and with them, your Exide Dealer puts off the day when you'll need a new battery. When you must get a battery, get a dependable, long-lasting Exide. Buy to Last—Save to Win.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 32

Exide Batteries of Canada, Limited, Toronto

EXIDES ARE USED IN MORE THAN 100
APPLICATIONS BY OUR ARMED FORCES



- 1 Don't buy anything you can do without.
 - 2 If you **MUST** buy, insist on dependable, long-lasting merchandise.
 - 3 Take care of the things you have. Make them last.
- These conservation rules save materials for war production, help curb inflation, give you more money to invest in War Bonds.

VETERAN IN SEARCH OF A PEACETIME FUTURE

THIS veteran knows of no job to come back to after the war.

It was born of war necessity — built to perform a strategic purpose new in the history of aircraft.

The requirements were an engineering challenge. It had to be strong to do its heavy work. Yet it had to be light and fit in the small space available.

That is why even optimists doubted such a device could be built.

But here it is: The Lear Actuator.

Its job is operating flaps, landing gears, shutters and other equipment on the power of an ordinary storage battery.

Now, of course, our plants are working round the clock to make enough of these for Uncle Sam.

But we know that such unique devices, the midget motors that drive them and all the 250 Lear products, must have an important future in some peacetime applications.

They may park your car with the push of a

button — or do any of thousands of jobs we haven't thought of.

That is why we are telling you about them. We want to find jobs for these able veterans.

And at the same time we want you to know that there is available the kind of engineering thinking and production technique that made them possible.

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This measuring glass contains slightly over half a pint of gasoline. Mixed with about 75 cubic feet of air and metered into a Cyclone 9 engine, this cupful of fuel, in contributing its share of the total power, will produce one horsepower for one hour.

No other type of gasoline engine does as much work on this amount of fuel; your car would require about 20% more gasoline to produce 1 horsepower for 1 hour. In engineering terms, the Cyclone's cruising consumption is at the rate of 0.41 pounds of fuel per horsepower per hour. Cyclones have operated on extended flights at cruising power on 0.39 pounds per horsepower hour—even less under careful control—but 0.41 represents the average for millions of hours of routine operation.

Minimum fuel consumption is determined by the engine design, depending on such factors as the compression ratio, the induction system, and the contour, size, and cooling of the combustion chamber. The carburetor's function is to provide the most desirable mixture for its engine under various conditions, but it cannot determine fuel economy because an engine will not run leaner at a given power than its design permits.

On a ten-hour flight in a four-engined airplane the seemingly fractional difference in consumption between the Cyclone 9's average lean rate of 0.41 lbs. and the general average rate of 0.45 lbs. can amount to a saving of 160 gallons. The fuel saved with Cyclones represents almost 1,000 pounds of extra cargo or five additional passengers. In a year, this difference can mean a saving of 50,000 gallons on a four-engined plane—fuel approximately equal in cost to an engine.

★ ★ ★

Wright Cyclones pay their way.

Cyclones and Whirlwinds—Light—Compact—Powerful

WRIGHT *Aircraft Engines*



WHITE COLLAR or OVERALLS—



Which will YOU wear after the war?

HUNDREDS of thousands of white collar workers have put on war overalls for the duration. Millions of both white collar and overall workers have put on uniforms. Hosts of home women are patriotically taking jobs.

After the war, millions will be coming back from army, navy and air force to civilian jobs; great war materials factories will be re-converting to civilian production; old peace-time functions of business will be springing up—where will you fit in the situation?

If you are wise, you will look ahead and prepare. You will not wait on chance. You will analyze the probable conditions in peace employment, decide where your likes and aptitudes fit best, and get ready. You will decide whether your best opportunities lie in production or office or store. You will determine whether you wish to work for someone else or develop a business of your own. You will train now to be above the average and, therefore, surer to get the opportunity you want after the armistice.

Nor will you wait very long. Nobody knows when this war will end or how soon this problem will hit you in the face.

We Can Help You Decide

If you have some question either about postwar opportunities or about your own fitness for some particular one, probably we can help you. In our 34 years, over one million adults have enrolled for our training, we have built training courses for many

major fields of commerce and industry, and we have gathered a wealth of information about job opportunities and requirements. That information is at your service.

We Can Help You Prepare

And when you have decided what field of work offers most to you for a life career, we can help you prepare for it—quickly, economically, thoroughly, in your spare time and without any interference with your present work—if it is in the list below. A 48-page booklet on the field of your choice, discussing the field and our training for it, has been prepared to help answer your questions. The coupon below or your letter will bring it to you, without cost or obligation.

Do not delay. Whether the war lasts six months or three years, now is the time to make sure your preparation for postwar success shall not be “too little and too late.”

La Salle Extension University A Correspondence Institution

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CHICAGO

I want to pick my career for after the war and get ready for it now. Send me your free booklet on the field I have checked below and full information about your training in that field.

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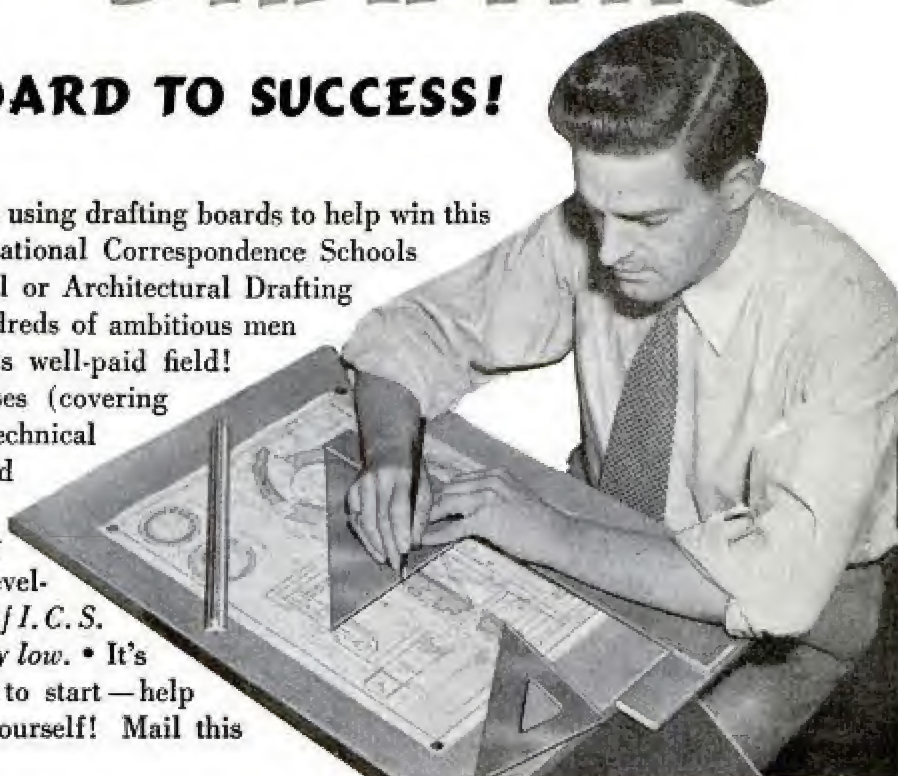


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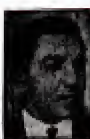
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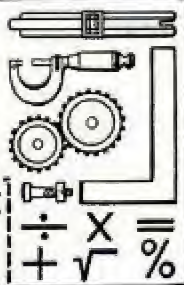
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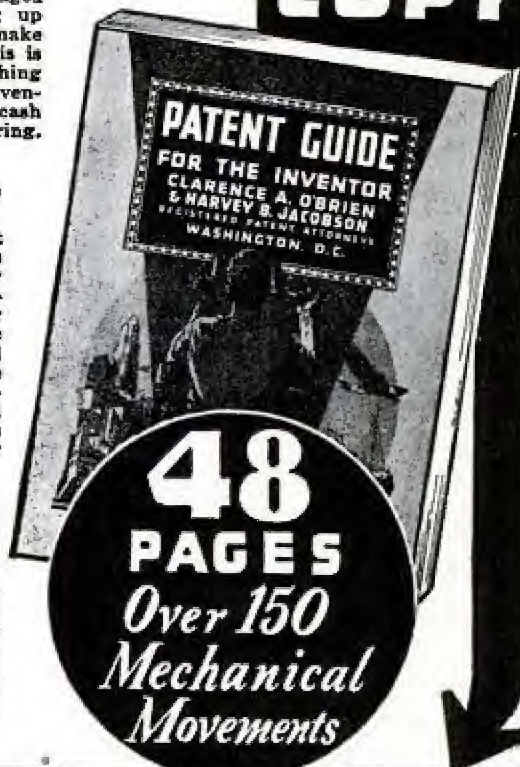
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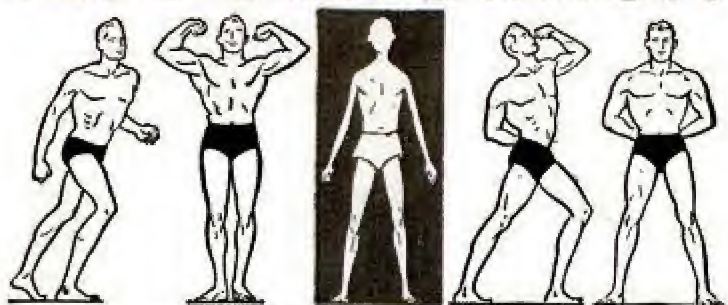


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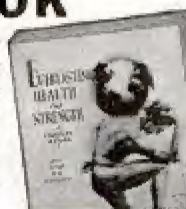
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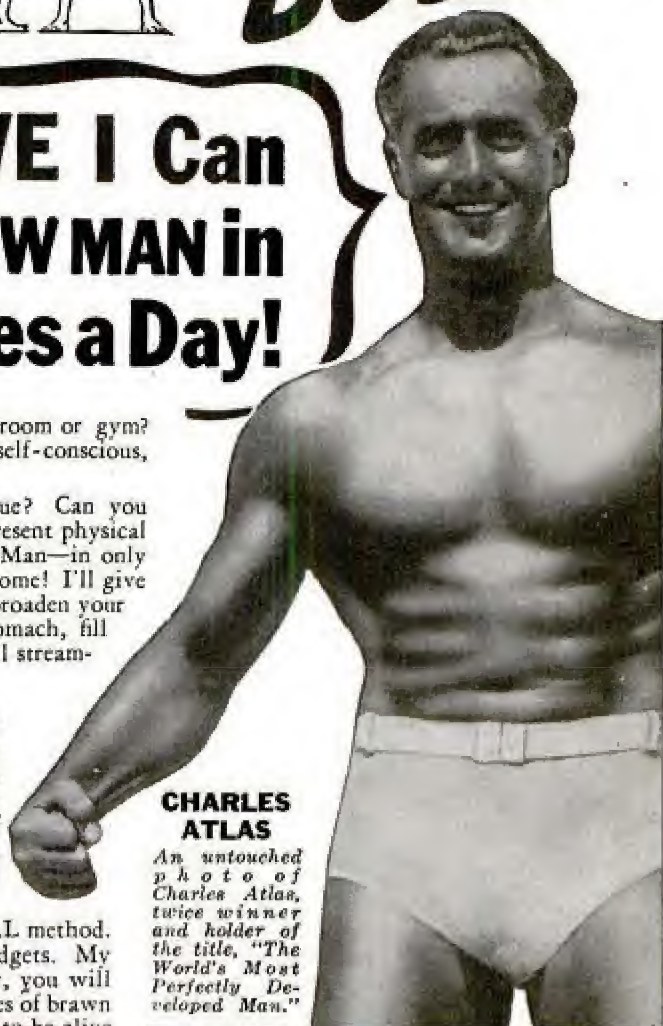
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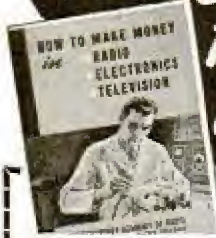
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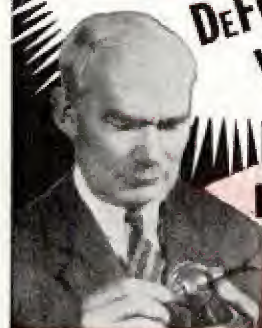
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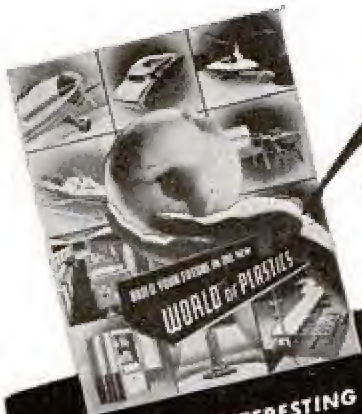
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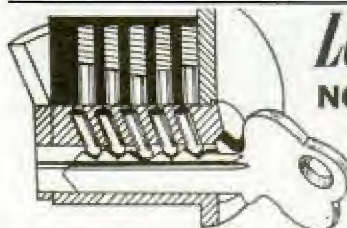
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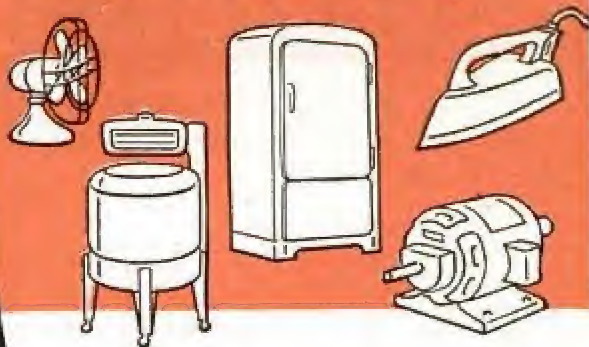
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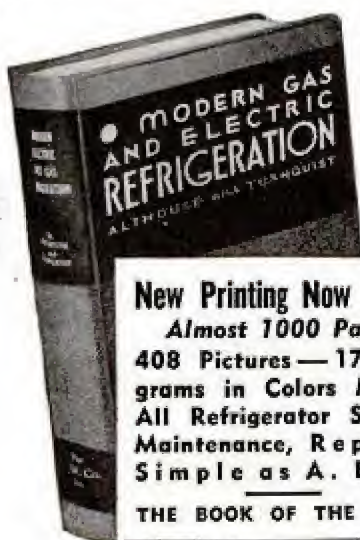


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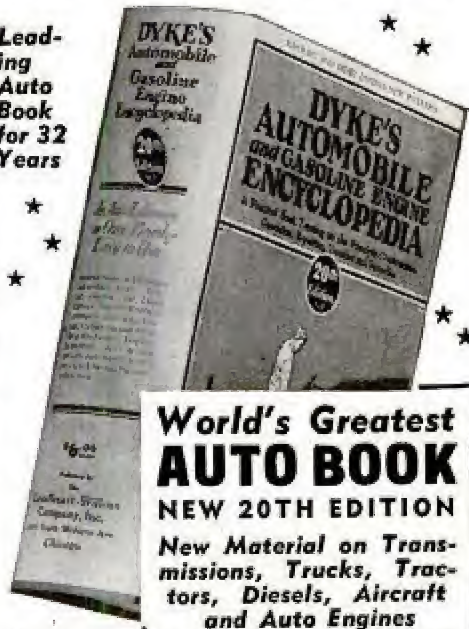


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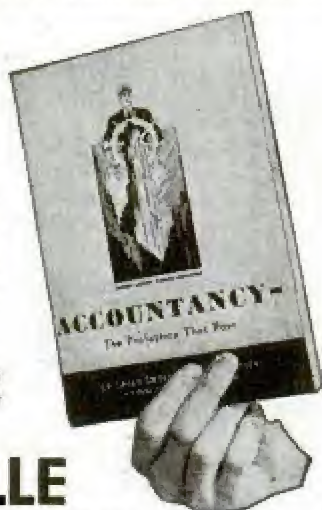
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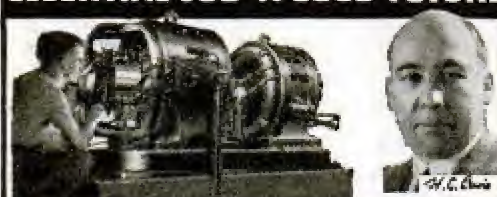
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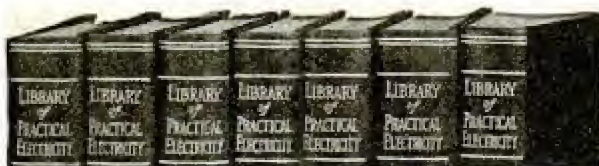
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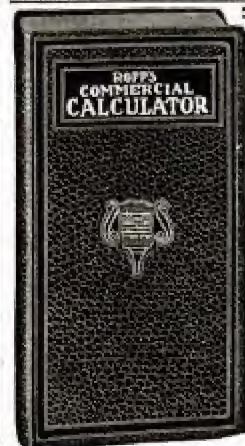
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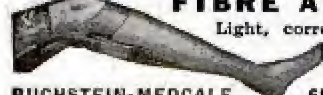
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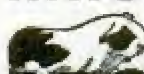
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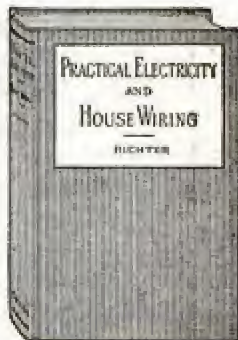


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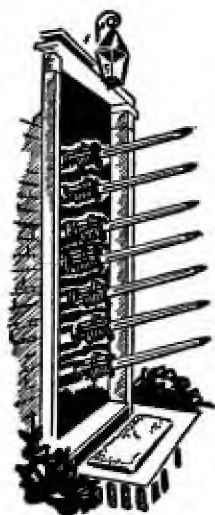
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As prices rise, people will ask for—and, in many cases, get—higher wages. That will put up the cost of manufacturing, so up will go prices again. Then we'll need another pay raise. If we get it, prices rise again. It's a vicious circle.

The Government has done a lot to help keep prices down. But the Government can't do it all alone. It needs *your help!*

Your part in this fight won't be easy. It may even mean doing without a few necessities. Tough? Maybe... but don't say that where the veterans of Italy and New Britain can hear you!

You want to do your part, of course. So do we all... farmers, laborers, white-collar workers, business executives. And the way to do your part *right* now is to observe the following seven rules...

1. Buy only what you NEED. And before you buy anything, remember that patriotic little jingle: "Use it up. Wear it out. Make it do or do without."

2. Keep your OWN prices DOWN! If you sell goods, or your own time and labor, *don't ask for more money* than you absolutely must! No matter who tries to talk you into asking more... *don't listen!*

3. No matter how badly you need something... never pay more than the posted ceiling price! Don't buy rationed goods without giving up the required coupons. If you do, you're helping the Black Market gang.

4. Pay your taxes cheerfully! Taxes are the cheapest way to pay for a war! The **MORE** taxes you pay now—when you have some extra money—the **LESS** taxes you'll pay later on!

5. Pay off old debts. Don't make any new ones! Get, *and stay*, square with the world!

6. Start a savings account. Make regular deposits, often! Buy life insurance. Keep your premiums paid up.

7. Buy War Bonds... regularly and often! *And hold on to them!* Don't just buy them with spare cash you can easily do without. Invest every dime and dollar you don't actually **NEED**... even if it *hurts* to give those dimes and dollars up!

**Use it up...Wear it out.
Make it do...Or do without.**



A United States War message prepared by the War Advertising Council; approved by the Office of War Information; and contributed by the Magazine Publishers of America.

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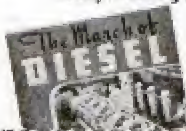
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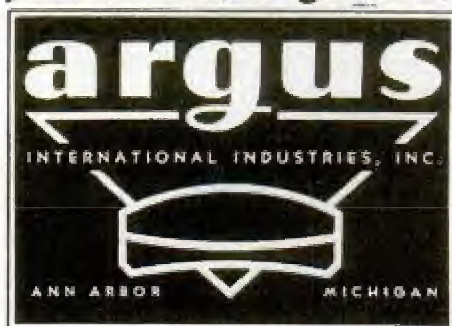


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71 925

Vol. 81

APRIL, 1944

No. 4

PISTOL-PACKIN' WARPLANES



Tracer bullets fired by student gunner cut fiery path in night sky. Below, fighter's wing bristles with .50-caliber guns

NEW developments in firepower are making American fighting planes the most formidably armed in the world.

Among the accomplishments that are, or soon will be, paying dividends in enemy planes shot down and Allied aircraft returning safe are the following:

Increased firepower for nose and tail positions of all types of bombing planes; power-driven nose turrets in heavy bombers; interchangeable nose turrets in one light bomber; heavier guns; remote-control fire control systems; hydraulic and electric turrets with multiple guns; remotely controlled and power-boosted hand-held machine gun mounts; multiple gun turrets for night fighters; forward-firing fixed 20-millimeter cannon in a light bomber; fighter gunsights which extend

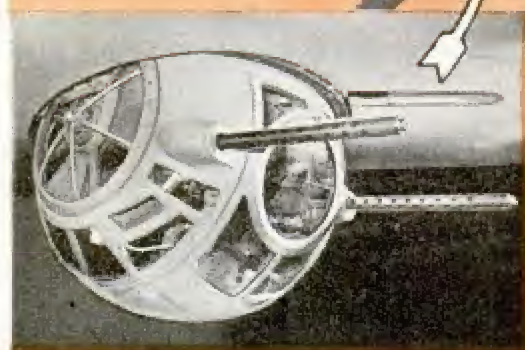
sighting ranges; fixed gun installations for fighter aircraft to provide automatic corrections for lead, range, altitudes and speed; improved computing sights; combination gunsights and dive-bombing sights; personnel flak suits and armored helmets;



APRIL, 1944



The power-driven tail turret of the Liberator, above, packs two .50-caliber guns. Below is the Sperry ball-turret, also with two 50's



The Consolidated B-24 Liberator (center) is one of our most heavily armed aircraft, with 13 .50-caliber guns. Above is the top turret, which makes 360 degree rotation. Below, new hydraulic-type nose turret



16-millimeter camera in nose of a fighter plane takes movie of air action



improvements in armor and bullet-resistant glass; improvements in the gunsight aiming point camera; placement of guns for maximum protection.

Creating firepower—the sting in aircraft—is the job of the Armament Laboratory, Materiel Command, Army Air Forces, at Wright Field, Ohio. This task has been made somewhat easier by development of America's .50-caliber machine gun, a weapon that fits easily into all types of U. S. aircraft. Weighing about 65 pounds and capable of firing 800 rounds per minute, this gun uses a shell so small that up to 1,000 rounds per gun can be carried. The projectile leaves the muzzle at approximately 3,000 feet per second and packs sufficient wallop to kill a man at four miles. At the usual air fighting ranges, the shell can penetrate all parts of an enemy aircraft.

According to Colonel Frank C. Wolfe, Chief of the Armament Laboratory, the number of guns carried depends largely on the airplane's configuration. In bomber types, the guns are mounted usually in



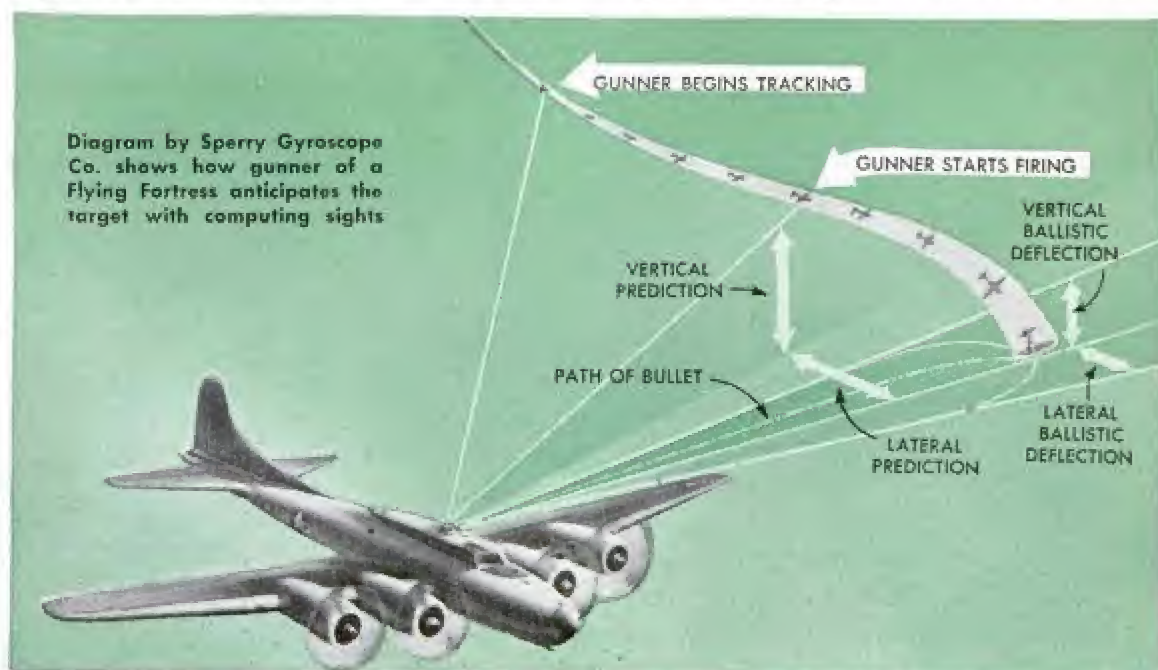
Above, "heavy artillery" on wings—a 75-millimeter gun in nose of a B-25 Mitchell. At right, machine guns and other weapons are test-fired to destruction in laboratory



pairs distributed from nose to tail to afford protection from every direction. In fighters the number varies from four to eight. It is estimated that when all eight .50 caliber guns on Republic's P-47 Thunderbolt are firing, the bullets deliver to an enemy target more horsepower punch than the 2,000-horsepower engine which powers the plane. Similarly a flight of thirteen Thunderbolts has three times the striking power of a machine gun unit of a German infantry regiment; a formation of 13 bombers, car-

rying a new heavy cannon now going on some medium types, has twice the firepower of the 75 howitzer used by the German regiment.

Computing sights have been used on American bombers for some time, forcing the enemy to stay out of range. These sights are being improved continually. The problems involved in correcting completely for aircraft gun-laying are numerous and, to obtain hits, they must be solved to a fine degree of accuracy. These solutions include





Above, the "little black box" that aims turret guns of big bombers. Right, a frame from gun camera film

accurate and instantaneous computation of and correction for lead and ballistic variations caused by altitude, range and speed of the firing airplanes. In fact, Colonel Wolfe says, the corrections obtained through use of computers parallel those of the bombsight, but actually involve a greater number of factors which must be solved with even less assistance from the gunner.

Although computing sights have been limited to turrets in bombers and attack planes, computing sights have been developed for all other gun positions.

Fire control for aircraft has been developed to an art. One version is a remote control system by which the gunner and his weapons can be separated; resulting in



less vibration for the sighting mechanism, less fatigue for the gunner, and increased accuracy. One development of this type is the "chin" turret on the latest B-17, replacing the hand-operated machine guns. An electrically operated turret, with .50 caliber guns, guards the Consolidated Liberator's nose.

What is adequate firepower for any given type? No one can answer the question put like that. Each airplane must



be given different treatment. The new B-29 super-bombers must be presumed to have vastly greater firepower than any fighting craft in the world. The B-29 is larger than the B-17 or B-24, therefore has a larger area to protect; also having a greater range, must depend upon its own guns over areas where fighter "umbrellas" cannot operate.

Among the devices used to improve the accuracy of gunners is the gunsight aiming-point camera, mounted behind the gunsight so that pictures of the sight reticle may be taken on 16-millimeter film. In this way, it is possible to capture on film exactly what the practicing gunner has

The Boeing B-17 sticks out a new chin turret—its whisks two .50-caliber guns

U. S. Army Air Forces photo

seen through the sight and corrections may be made in his aim. The camera also has been used in actual combat.

In determining the accuracy of gunfire following automatic computation, there are two main factors, tracking and ranging. Tracking means keeping the gunsight precisely on the target; ranging is manipulation of the sight's range-measuring mechanism to keep the correct range constantly in the computer. Thus, if the gunner fails to track smoothly and range precisely, inaccurate data will be given the computing gunsight. The aiming point camera reveals any such deviations in aim.

Some of the armament testing facilities are "cold rooms" for test firing at very low temperatures, outdoor and indoor firing ranges, high altitude pressure chambers, computer and sight testing apparatus, and electronic tests. At Wright Field, guns and related equipment are tested in temperatures down to 60 or 65 degrees below zero, and in extreme heat. The Armament Laboratory also houses a "torture chamber" in which various guns and cannon used in aircraft are subjected to life tests, being fired continuously until some part breaks down. In this manner, any inherent weakness may be detected long before the guns are sent into combat.

Varying conditions of aerial warfare bring the necessity for modification of aircraft, changes that will enable Allied pilots and crews to inflict more damage on the enemy or provide a better defense. For instance, there arose the need for a night fighter, with special equipment, to be used in sweeps over Europe after nightfall. The British had been using the Douglas A-20, with modifications, for these "intruder" actions, sweeping low over enemy airfields and other installations to bomb and machine gun buildings, aircraft, gun emplacements and personnel. To make this type of action more effective, the Armament Laboratory initiated developments which resulted in recommendations for a definite night fighter type. Now America has the ship, a conversion of the A-20. Designated as the P-70, this craft carries special guns and other equipment, and is so designed as to give greater visibility, so necessary in night flying operations.

Super Dive Bomber of U. S. Navy Increases Range and Speed



Curtiss-Wright Corporation, Inc.

Navy "Helldivers," the new Curtiss-Wright dive bombers which recently made a sensational debut in the South Pacific, carry a greater bomb load faster and farther than any similar craft in the world. The bomber, designed for either carrier-based or land-based operations, is a two-place, all-metal, low mid-wing monoplane possessing maximum striking power. It is speedy enough to keep up with the Navy's new fighter escorts. Between June, 1942, when the first production model was tested, and November, 1943, 889 major design changes were made, many of them dictated by combat experience. One hundred and fifty pounds of armor plate were added behind the pilot and gunner, self-sealing fuel tanks and protected oil lines installed, and the flap mechanism was re-designed to enable the pilot to open or close the flaps three times faster. Among dive-bomber innovations are the housing of the entire bomb load within the belly of the fuselage, and a folding "turtleback" which collapses in combat to assure excellent visibility for the gunner. In the development of the Helldiver, the biggest problem confronting Curtiss engineers was to design a high speed bomber with slow stalling speed that would permit landing on carriers.

(Scientists at Purdue University have developed a method of producing menthol synthetically from thymol, found in oil of thyme, of which there is no current shortage. The synthetic menthol has the same taste and odor as natural menthol, and pharmaceutical differences are slight.

77. 847

Giant "Chess Board" Guides Floor Planners



Three-dimensional models used in experimental layout account for every inch of floor space and show clearance for cranes

Below, stakes in this game are more Flying Fortresses. Boeing planners shift models of machine tools on floor plan of shop



Seattle 1/47 Wash.
When a foreman in the Boeing Aircraft plant wants to rearrange his work area, the suggested changes are first "played" on a huge "chess board" guide. Instead of the conventional knights, rooks and pawns, the Boeing planners use models of machines and work benches. The board consists of metal sheets marked off in squares, each representing four square feet of floor space. The models are marked to show where power lines plug in, and while some show only the floor space required for a particular piece, others are

built up to scale height so clearance may be judged for cranes. When the final setup is approved, the models are photographed as a "blueprint" for shop movers.

Navy Officers "Play" With Toys to Learn Ship Loading



77 902
Students at the Stevardoring School on the East Coast are being taught modern methods of handling cargo with the aid of a 27-foot scale model of a Liberty ship, complete with deck fixtures. The model's starboard side is cut away to permit observers to look into holds of the ship, to mark the proper storage of cargo. The model is built on a scale of three-quarters of an inch to a foot.

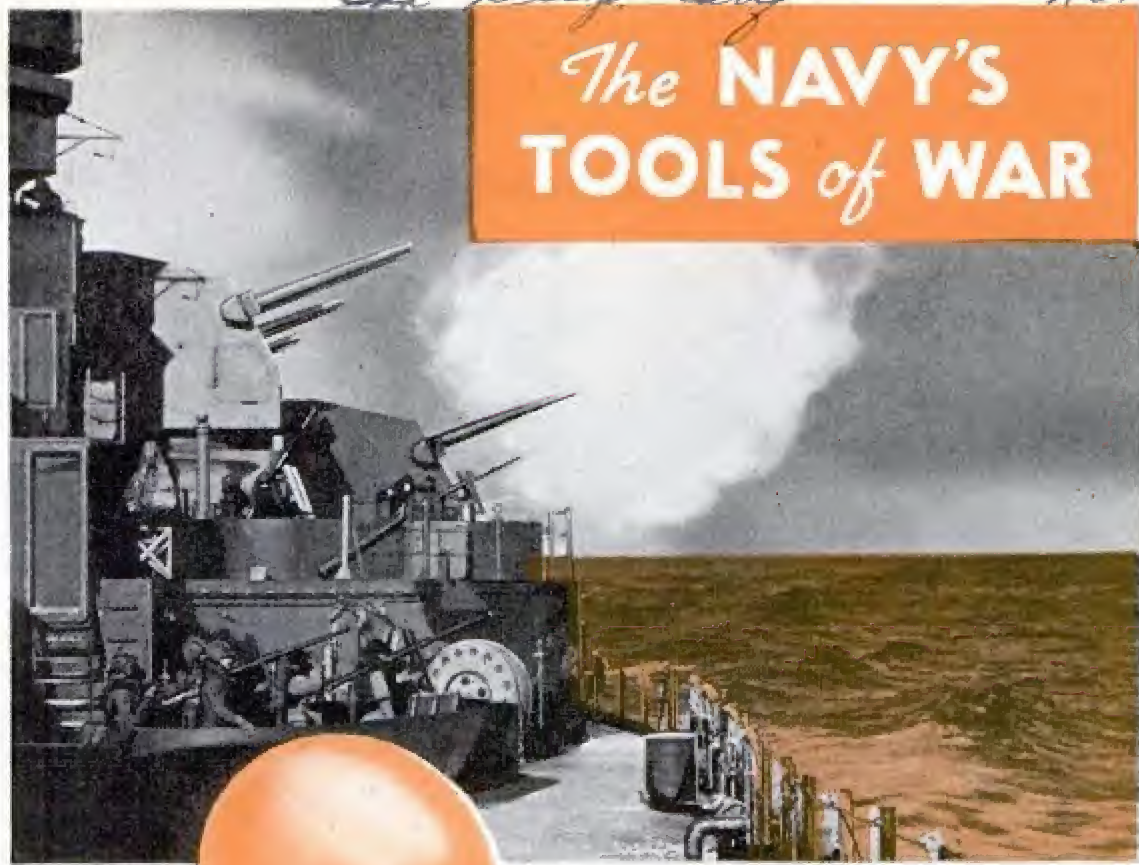
¶Sixty million rats caused damage estimated at more than \$200,000,000 in the United States during 1943.

This 27-foot scale model of a Liberty ship has complete deck fixtures

St. Andrew Hamilton, 7283 Hamilton St.
San Diego, Calif

71845

The NAVY'S TOOLS of WAR



U. S. Navy photos

A battleship's battery of fast-firing dual-purpose guns sends shells high in air to scatter fragments over wide area. Below, releasing balloons as antiaircraft targets

By
Rear Adm. W. H. P. Blandy

NAVAL ORDNANCE today is a far cry from what was meant by the term in sailing days, when you loaded your smoothbore guns with black powder and round shot, and boarded your enemy with cutlass and pike, pistol and dirk.

You aimed your guns in those days by "sighting down the line of metal." You fired on the uproll to cut up your enemy's spars and rigging if you wanted to take his ship as a prize; on the downroll into his hull if you wished to sink him.

Today, Naval ordnance comprises guns of all calibers, from half an inch to 16 inches, weighing from 100 pounds to 100 tons; their mounts ranging from a slender pedestal of 300 pounds to an armored three-gun 16-inch turret



Until recently Chief of the Navy Bureau of Ordnance, Admiral Blandy has been given a command at sea. This article is a condensation of a speech he delivered before the Detroit Economic Club



Hard-hitting scout bombers roll across the deck of an aircraft carrier, above. In the blister turret of a Navy PBX patrol bomber, below, a gunner is adjusting the sight of his .50-caliber machine gun



It includes also heavy armor, some of it thicker than the 16-inch shell it must keep out; torpedoes, for destroyers, cruisers, PT boats, submarines, airplanes; bombs and bombsights; mines; depth charges and their projectors; nets and booms for protecting a Naval anchorage; flares, rockets and other pyrotechnics.

In other words, Naval ordnance includes everything which is thrown at the enemy by ships and Naval planes, the weapons which do the throwing, instruments for improving their accuracy, and protective devices to parry the other fellow's blows. And it has extended its field from the surface of the sea to hundreds

weighing as much as a whole destroyer; armor-piercing, antiaircraft, incendiary, illuminating, shore-bombardment projectiles; fuses and high explosives for bursting these shells; and smokeless powder in metal cases or silk bags to discharge them at great velocity. It also includes hoists and rammers to bring the ammunition from the shell rooms and magazines and load the guns; range-finders, computing instruments, transmitting and receiving instruments, and gun directors.

of feet below and thousands of feet above it.

If you are going after a battleship, you've got to use an armor-piercing bomb to sink her, for the modern battleship has a protective deck about half a foot thick over her vitals, and the tops of her gun turrets are just as heavy. The "general purpose" or demolition bomb, with a thin case and a lot of explosive, just won't do the trick.

I've seen a turret top which had been hit with such a bomb. The only repair equipment needed was a paintbrush. Nobody

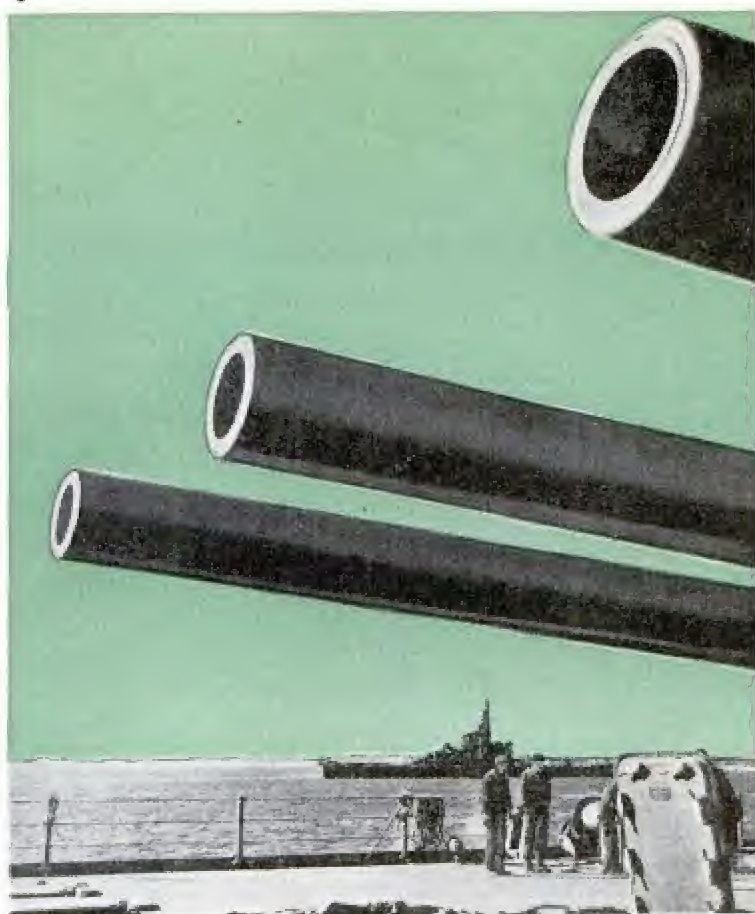
inside the turret was injured except the turret officer, whose ear was scratched by the periscope, the upper part of which was thrown back violently by the blast.

To get through heavy armor, a bomb, like a shell, must be specially designed. The principal features are a delayed-action fuse, a very thick wall and heavy nose, and a small bursting charge. It must of course have plenty of striking velocity. The latter can be achieved only by dropping from high altitude, or by diving at extreme speed. In either case, accuracy is difficult.

Even at medium altitudes, to bomb a point target like a ship accurately in horizontal flight requires a precision bombsight. The Norden bombsight is still the finest known. It was designed by Mr. Carl Norden and developed jointly by Mr. Norden and the Navy's Bureau of Ordnance, which furnishes this sight to both Army and Navy.

While light-case bombs cannot sink a battleship, they can seriously damage her communication equipment, exposed fire-control stations, the lighter anti-aircraft batteries, pierce the light upper decks and start fires. The same bombs can sink lighter Naval vessels, and of course transports and cargo ships. Against the latter, if unarmed or poorly armed, the bombs can be delivered by "masthead" bombing which is just like dropping a message on the deck, though less polite.

The best plan of attacking well-armed ships with bombs at short range is dive-bombing. You must have planes specially built to stand the terrific stresses of the pull-out. The planes push over at altitudes high enough to afford fair protection from the ships' guns, take advantage of cloud cover or a brilliant sun if available, and come down "like a bat out of hell," at



Two of Uncle Sam's new battleships ride at anchor off the coast. In the foreground are three of the nine 16-inch guns of the main battery. Below, signaling with blinker. Note new helmet on man with headphons





"Wolf packs" of fast, long-range patrol torpedo boats are one answer to the wolf packs of submarines

an angle as steep as 70 degrees in the final dive. The maneuvering of the target ship interferes considerably at times, but a good pilot can take care of it.

The percentage of hits is usually much higher than in level bombing at high altitudes. So also is the percentage of plane losses, though much less than the low altitudes reached would indicate: The ship's gunners are firing with the guns elevated to difficult and awkward angles, the sun may be in their eyes, the ship is probably swinging violently, heeled over and maybe rolling. Theirs is not an easy job.

But to sink ships, it's always better to let water into them instead of air. That's where the torpedo comes in. Deadliest weapon of the sea, it is also the most difficult to make, maintain, and adjust.

You have heard of "one-man submarines." A torpedo is literally a "no-man" submarine; and it is dropped from the air at such heights and such speed as would break every bone in a man's body, and make a mass of junk out of a car or plane. Yet the 5,000 parts and intricate assemblies of the torpedo must take this beating and then propel and control and explode this underwater hell-cat as if launched from a barge or pier.

After its initial dive, the torpedo must take and hold the exact depth set on the index. This might be 10 or 12 feet for a destroyer or light cruiser but much deeper for a battleship (this Goliath must be hit below the belt—the armor belt—or you won't hurt him much.)

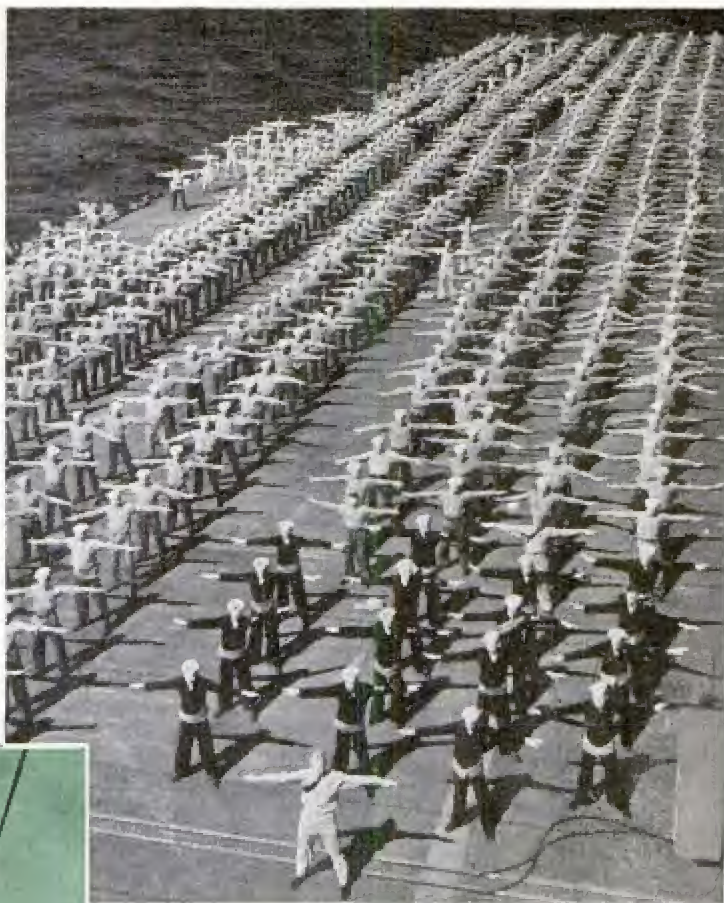
The slippery messenger of death must



Hundreds of pounds of TNT geyser up as a "YP" off Florida coast drops depth charge

steer a straight course with only a gyro for a helmsman. And of course it isn't just aimed straight at its moving target, or it would pass astern. Just where it should be aimed is a neat little problem in geometry, based upon the enemy ship's course and speed, direction of the ship from the plane, and the average speed of the torpedo, throughout both air and water travel. The final duty of a torpedo is to explode when it hits the target, and not when it first hits the water.

Submarine torpedoes are much like those used by aircraft, but are larger, and don't have to be beefed up to stand the blow due to dropping from a height. They are discharged from the submarine's tubes, in bow and stern, by com-



Even in war zone, officers and men aboard a U. S. aircraft carrier exercise daily to keep in tip-top condition



pressed air. The sub can throw them straight, or pitch some fancy curves. Curved or angle shots are accomplished by setting the gyro for the final course, and then firing the torpedo with the rudder locked right or left until that course is reached, when the rudder automatically unlocks and the gyro takes control.

Another Naval air weapon is the anti-submarine depth bomb, which can be set to explode by hydrostatic pressure at any depth

A casualty of the hard fight that won Attu away from the Japs is swung from a ramp boat to ship in Massacre Bay

Dual-purpose guns of an American warship guard a convoy of troop and cargo ships on way to Mediterranean





Aboard a Yankee submarine an officer sights an enemy ship through the periscope as crew mans battle stations

desired. I think submarine men agree that this bomb used by the airplane, with the pilot's wide horizon, his "plan view" of the sea, and his ability to strike swiftly, is one of their greatest hazards.

Depth bombs and depth charges must explode only a few yards from the tough hide of the modern sub, to deliver a death blow. But at greater distances, serious and even disabling damage can be done to

lighting, hydroplanes and rudders, batteries, fuel tanks, and instruments, and of course it doesn't help morale.

There are exceptions to this statement. One was a Negro mess attendant on his first patrol in one of our subs. The skipper had just neatly torpedoed a large ship escorted by destroyers, and was "grabbing for the bottom." Every destroyer in the screen was on top of him in no time. Down came the depth charges, exploding with terrific force. Men were knocked down, all power was temporarily lost, and everybody in the crew was feeling pretty glum.

That is, everybody but Jones. He sat on a stool in a corner of the control room, chuckling louder in blissful ignorance with each explosion.

Finally, he burst out, "Captain, we sho' is givin' 'em hell, ain't we?"

Closely akin to the torpedo is the naval mine, one of the most ingenious destructive devices



The 14-inch guns of a battleship arch shells across the horizon in a "softening up" bombardment

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7866

Toothbrush Holds Dental Floss

Dental floss can be manipulated easily when mounted on a holder which is part of a toothbrush handle. The floss is secured to the turned-down end of the handle and carried back to notches part way up the handle. By placing the forefinger against the floss, the effect is that of a saw which is fitted easily between the teeth.



J. A. Lendie
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Canton, Ohio

known. Weighing up to a ton, and exploded in numerous ways by the influence of a passing ship, they may be laid by surface ships, dropped by planes, or pushed out of the torpedo tubes of submarines.

Some mines are of contact type, some magnetic, some acoustic, and some are detonated from the shore by electric cables. The magnetic mine, contrary to popular belief when the Germans introduced it early in the war, is not drawn like a magnet to the ship's side; the mine stays on the bottom. The magnetic field which surrounds the ship generates a current in the mine's firing device, and explodes the charge. The counter measure is degaussing, passing current through coils around the ship to neutralize its magnetic field.

The 6-inch rifles of our modern light cruisers have no equal for fast, accurate shooting. These weapons are mounted in five 3-gun turrets, and fire shells weighing something over 100 pounds. When cruiser meets cruiser, it's just as well to have a few of the heavy 8-inch type. A 10-gun salvo of 250-pound armor-piercing shells from one of these ships polished off the Jap cruiser which was firing on the Boise off Guadalcanal.

These heavy cruiser 8-inch guns, like the light cruiser 6-inch, are also useful for shore bombardment. All shells used for this purpose have thin walls, correspondingly large explosive charges, and instantaneous impact fuses. Heavy and light cruisers and destroyers use their batteries against shore objectives just like land artillery, in preparation for the infantry assault. Planes also bomb shore installations effectively; but when you can get ships into position for bombardment, they have the advantage of continuous fire, while a plane, after dropping its bombs, must go back and reload.

The most powerful engine of destruction used at sea is still the big gun of the battleship. Of 16-inch caliber, weighing about a hundred tons, firing one-ton projectiles which travel half a mile a second, the latest United States battleship main battery gun has shown itself well worthy to retain its place on the Naval team.

The process of laying guns for long-range fire involves all sorts of abstruse data, such as courses and speeds of firing ship and target, wind velocities and barometric pressures, powder temperature, and even an allowance for the rotation of the earth during the flight of the projectile. But all this data is incorporated into the problem almost automatically and in amazingly brief time.

A fire controlman in the foretop operates a sort of super-gunsight called a director,

(Continued to page 162)

Mr. G. W. Moore
1362 W. Dearborn, Chicago

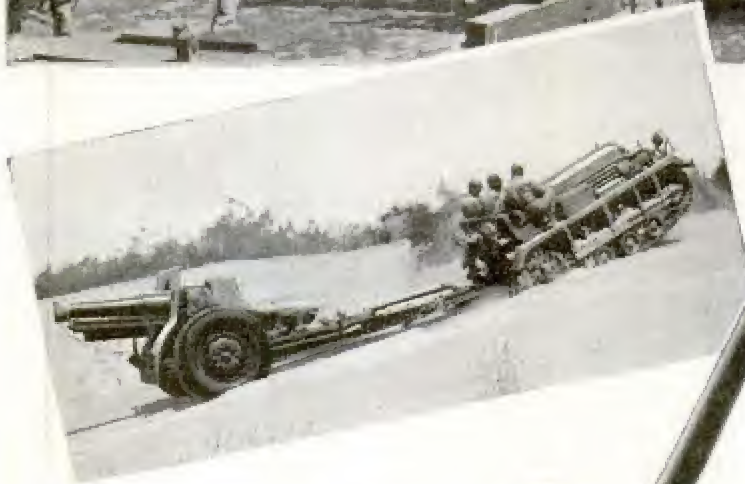
GUNS on WHEELS



Signal Corps photos

Getting guns into strategic positions "fastest with the mostest" firepower is accomplished with artillery on wheels. To meet the swiftness of attack by mechanized units, or to prepare new positions against assault from the air, calls for fast-moving artillery. Above, coast artillery antiaircraft regiment on maneuvers moves a 90-millimeter gun into position to repel an expected attack over ridge

An M-2 tractor digs into sand as it pulls big 155-mm. howitzer in desert



Officer candidates demonstrate manual operation of 40-mm. antiaircraft gun. Crew, from left to right, elevator setter peering through sight, the gunner, two ammunition carriers, and the azimuth setter who is busy measuring arc of the horizon





Ski patrol (above) swaps wheels for toboggan for winter transportation of heavy machine gun on difficult approach. Panel at right shows versatility of U. S. equipment. Top, at a Caribbean outpost, crew of 37-mm. anti-aircraft gun practices tracking planes. Center, 8-inch railway gun in position to blaze away at foe. Bottom, members of an infantry unit try out their 37-mm. gun in a mountain pass in Alaska. Below, huge 14-inch railway gun gives good account of herself during Army and Navy joint maneuvers in Panama and adjacent waters. It takes thousands of pounds of finest steel and rubber to give these guns mobility needed in modern war



*Pacific Car & Foundry Co.
Renton, Wash.*

77838

Army Tank Retriever Is Long as a Railway Car

Newest and biggest Army combat vehicle is the 25-ton tank retriever, a 10-wheeled behemoth built to go any place a tank can go, and to retrieve disabled tanks and take them back to repair stations. About as long as a standard railway mail car the trailer can hold one medium tank or two small



tanks. When loaded it weighs 80 tons, twice the weight of two loaded box cars. Each rim and tire of the huge vehicle weighs 900 pounds. To enable it to operate far from its base, the cab of the retriever is equipped with a small stove for cooking canned rations, and it carries large quantities of water, gasoline and oil, and complete repair equipment.

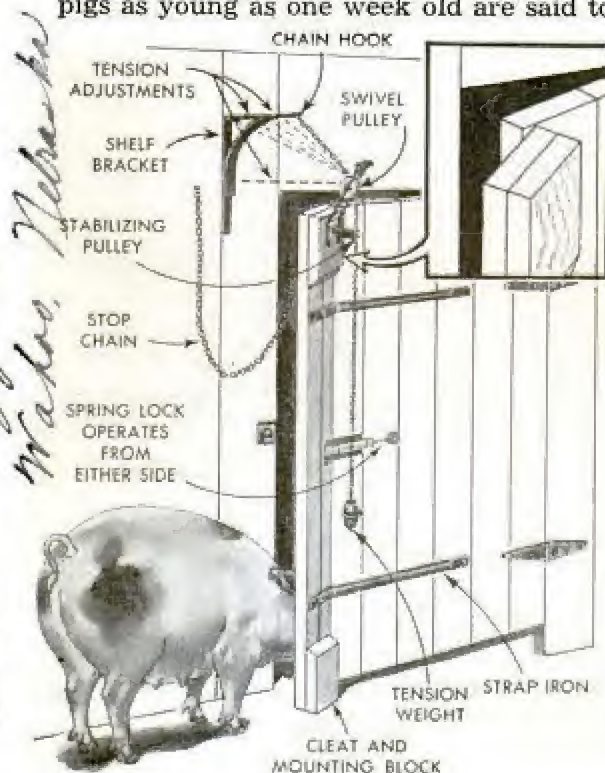
Hogs Operate "Swinging Door" That Keeps Out Drafts

By means of a wing attachment, the hog-house door may be made self-closing; yet pigs as young as one week old are said to

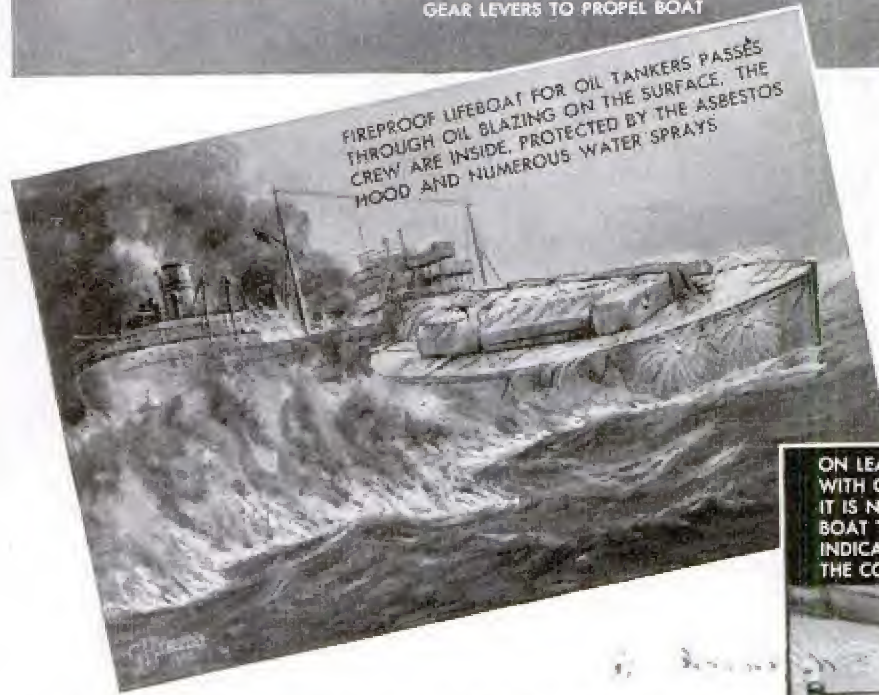
be able to operate the door with ease. Little pigs open the door by squeezing in behind the wing, and older hogs flip it open with their snouts. The wing is attached to any ordinary hinged door with two half-oval bars. A bracket bolts onto the building, and a weight on a chain passes through a pulley to attach to the bracket in any of several positions that will make the tension greater or less, as required. Chief advantage of such a door is that it permits the hogs free run of pen and runway, while also assuring ventilation without drafts.

Automatic File Finds Lost Bags By Sorting Card Index

Bus lines in the west have adopted an automatic card index system for locating lost baggage with a minimum of delay and confusion. For every lost piece of baggage the station master punches a hole in a card which contains pertinent items of description—type and color of bag, number of straps, and its contents. The card is filed in a modern index system. When an operator receives a report of a lost bag, cards relating to bags of that description can be found quickly by pressing appropriate buttons which automatically locate them.



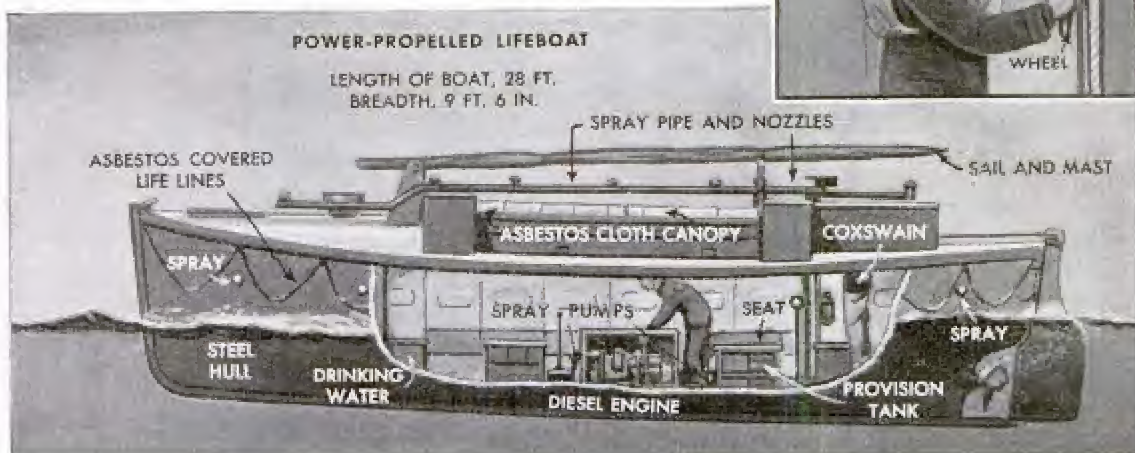
Water Spray Shields Lifeboat in Sea of Flames



Hand-operated model of fireproof lifeboat (above) is propelled by movement of gear levers backward and forward. The cutaway shows position of coxswain, who keeps craft running to windward with aid of indicator. British ordered 500 of these lifeboats built after successful tests

To save the lives of seamen on torpedoed tankers, British engineers designed this all-steel fireproof lifeboat which accommodates 33 men. A sliding asbestos hood and a shield of cold water ejected from numerous sprays mounted at various points, enable the boat to move through a sea of blazing oil. The lifeboat is built in two models, one manually operated, and the other (shown in cutaway below) has a small Diesel engine. It moves at five knots an hour

ON LEAVING A TANKER ON FIRE WITH OIL BLAZING ON SURFACE, IT IS NECESSARY TO STEER THE BOAT TO WINDWARD. A WIND INDICATOR IS FITTED TO ASSIST THE COXSWAIN



The TUBE that is REMAKING the WORLD



Westinghouse photo

By Roderick M. Grant

IT IS only an hour's travel from New York to San Francisco by the electronically controlled vacuum tube, a prophetic vision of Dr. Irving Langmuir, Nobel prize winner in chemistry.

Not tomorrow, of course. But this General Electric research scientist, looking far beyond the practical problems of wartime electronics, sees no fundamental reason why we could not travel at 2,000 to 5,000 miles an hour in magnetically suspended vehicles floating in a vacuum tube. He visions, too, an orchard without workers, cared for and cultivated and its fruit picked by machines governed by electronic controls.

Day after tomorrow, perhaps.

But the "house of magic" is already open for business. In a busy factory a little copper ring that might be a miniature lawn sprinkler encircles a tiny gear. As the operator presses a button, there begins an automatic sequence of seeming miracles.



Left, tube used for electrolytic tinplating. Above, RCA radio "sewing machine" stitches thermoplastic



High-frequency radio waves heat-treat gear in coil

In three seconds the gear is blushing cherry red. Seconds later, myriad jets of water spring from the ring to quench the red-hot metal. As the little cloud of steam clears, the gear is lifted away, its hide toughened for a long and hard life by the heat induced by those same high-frequency radio waves that carry voices around the world. Once the heat treatment by other means took minutes, even hours; now

*Radio Corp. of America, N. C. A. Bldg.
36 Rockefeller Plaza, N. Y., N. Y.*

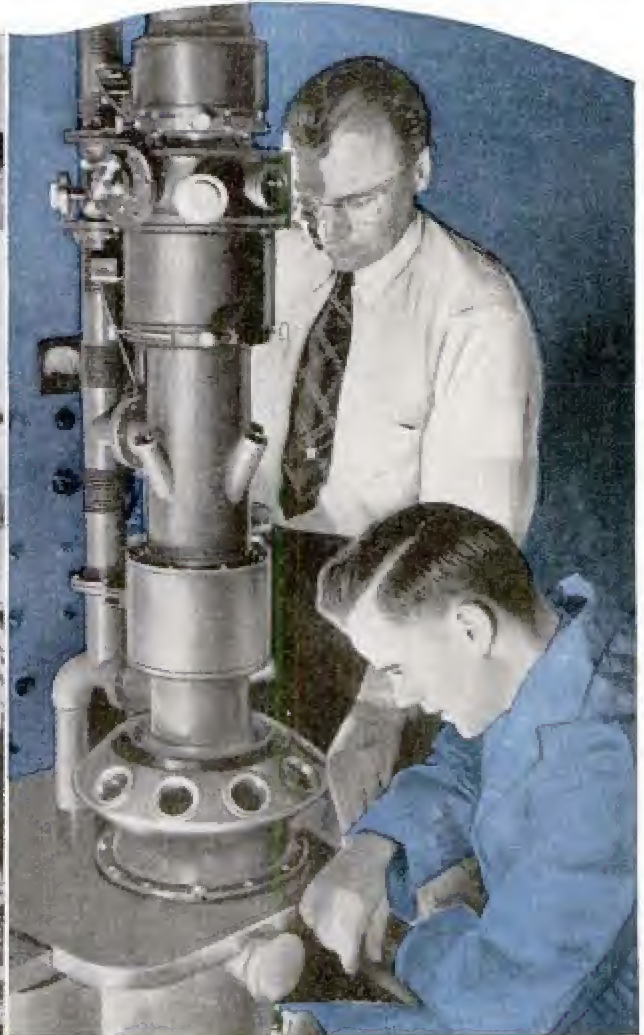
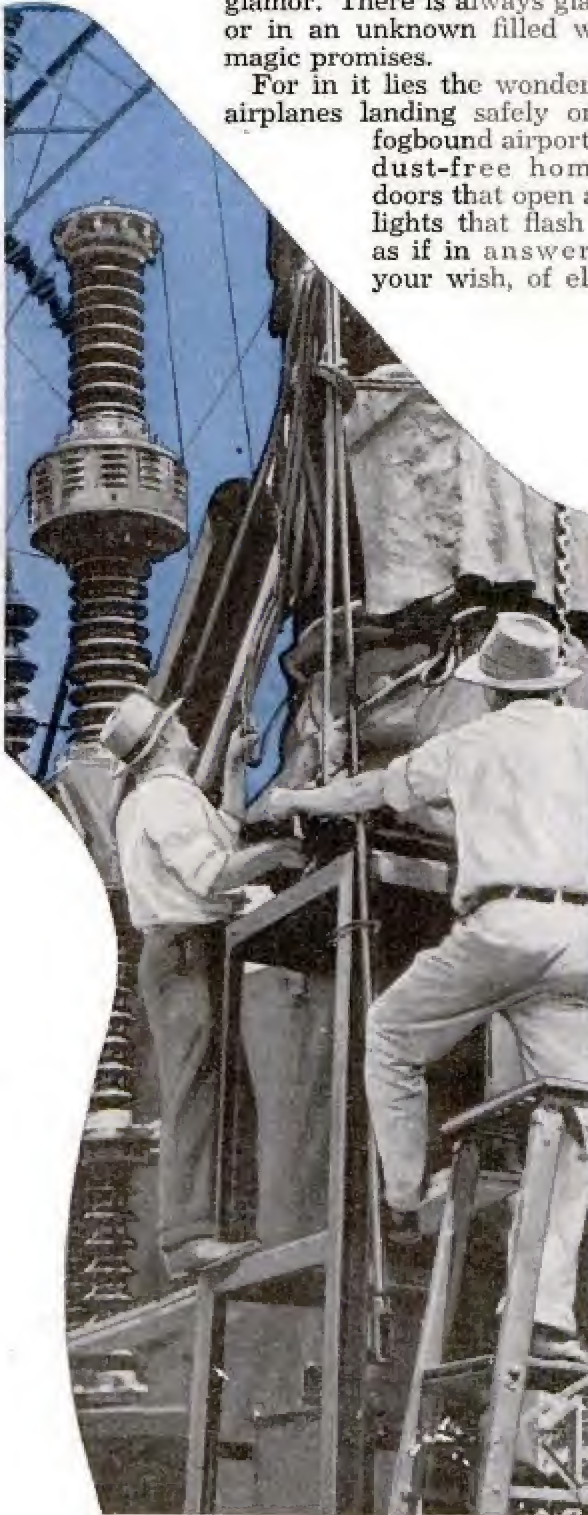
seconds. It is electronic magic at work.

Suddenly there is glamor in Electronics. What if the electron tube already has spent a generation at hard labor? What if more than 25 billion kilowatt hours—one tenth of all the vast pool of electric energy generated in the United States—flowed through electronic devices last year? What if electronics has long since reached voting age? Suddenly it has acquired glamor. There is always glamor in an unknown filled with magic promises.

For in it lies the wonder of airplanes landing safely on a fogbound airport, of dust-free homes, doors that open and lights that flash on as if in answer to your wish, of elec-



Above, electronic mass spectrometer analyzes gases in synthetic rubber production. Left, Westinghouse circuit breaker that blows out high-voltage arc with compressed air. Below, the RCA electron microscope





A Westinghouse research scientist demonstrates his electronic dealer—four electric eye circuits can sort cards into suits or deal poker hands

tron microscopes unveiling the mystery of the disease virus, of cathode rays revealing the speaker pink and natural as life when you lift your telephone receiver.

That is electronics in the world of tomorrow that will surely come when the economic world is ready for it. But there are oldsters who say to youngsters: "You can have your electronics and your dream world. To me it is just a five dollar word that wasn't in the textbooks when your old man went to school. Electrons are over my head; in my time I'll never need to understand them."

Yes, old man, electrons are over your head, and in your hair, and in your very substance. You may ignore them, but you cannot avoid them. They are on every fac-

tory payroll today. They answer your fingertip when you tune in the news broadcast from Chungking, when you pick up the telephone to talk with the boy at Lowry Field; they guard you as you ride the fast train and air liner, they heal your pain under the bombardment of high-frequency therapy.

To put it simply, electronics is the science of putting electrons to work, and the vacuum or gas-filled tube is the means to the end. Fluorescent lamps and radio tubes, X-ray tubes and television screens are all members of the family. So are the tubes that heat-treat steel and convert alternating into direct current,

and measure the scarcely perceptible electricity in your brain and heart. Tubes are available that will detect and measure currents far less than a billionth of an ampere, or generate frequencies of a billion cycles. There are tubes that will fit in a thimble, others that are bigger than a man.

Essentially a tube is a valve governing the flow of electrons. Boiled off from the cathode by a heater coil, or lured from it by light as in the phototube, the electrons stream toward the positive anode and close the circuit broken inside the tube by the gap of vacuum or low-pressure inert gas.

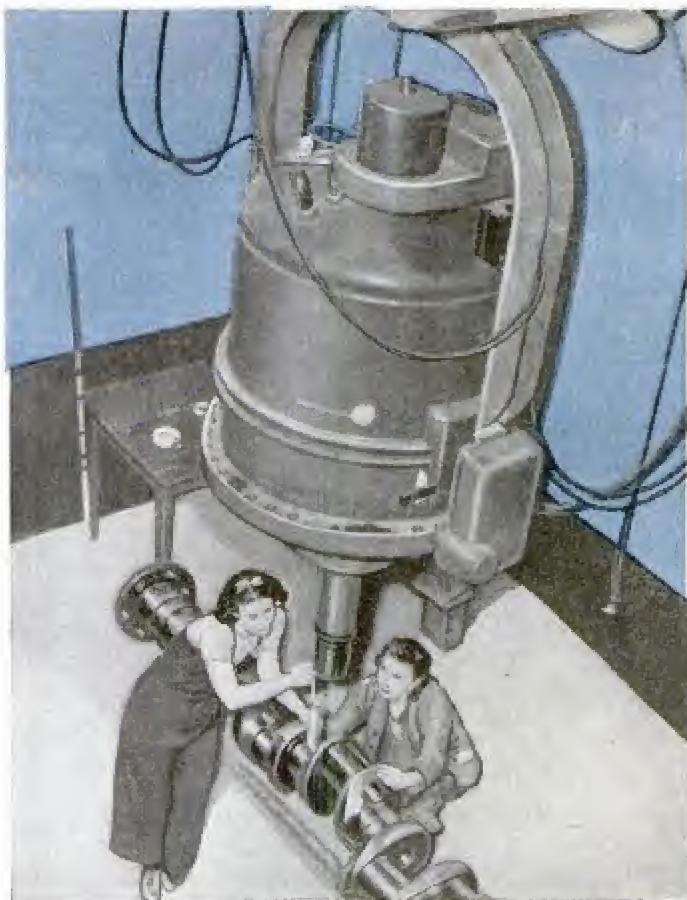
The volume of their flow can be controlled precisely by a grid, in simplest terms a wire mesh which functions like a venetian blind between cathode and anode.

An ordinary light microscope in General Electric laboratory made the photograph of a mosquito's wing at left. Feathers on edge of wing are shown magnified (right) by electron microscope



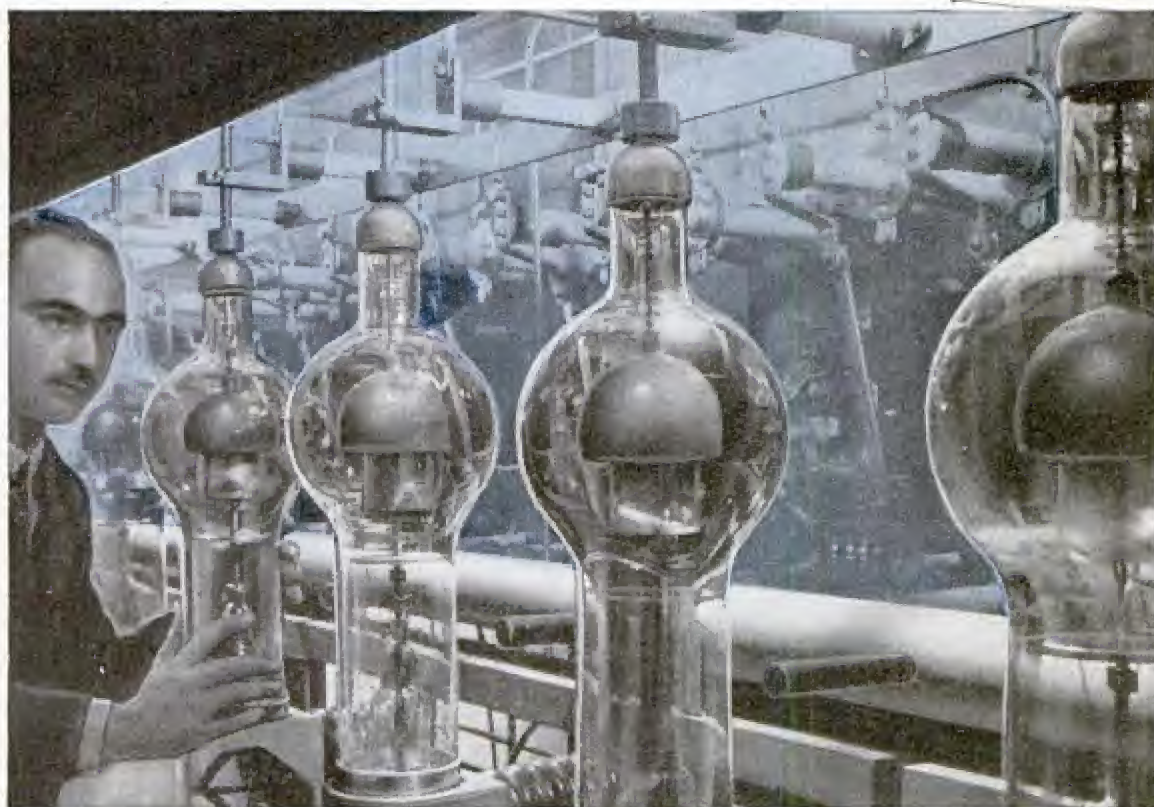
Positive voltage fed into the grid increases — amplifies — the outflow of negative electrons; negative voltage closes the blind, diminishes the stream. If the tube is used for radio reception, the grid is fed signal current from your antenna. If it is to amplify sound, the grid gets its orders from a microphone. If it is to respond to light signals, an electric eye governs the voltage on the grid. If it is to rectify alternating into direct current, the tube is connected in series with an a-c circuit; during the half-wave of a-c voltage when the anode is negative, electrons from the cathode are repelled and the current is interrupted, resulting in translation of the a-c flow into a pulsating direct current. The tube is a one-way street.

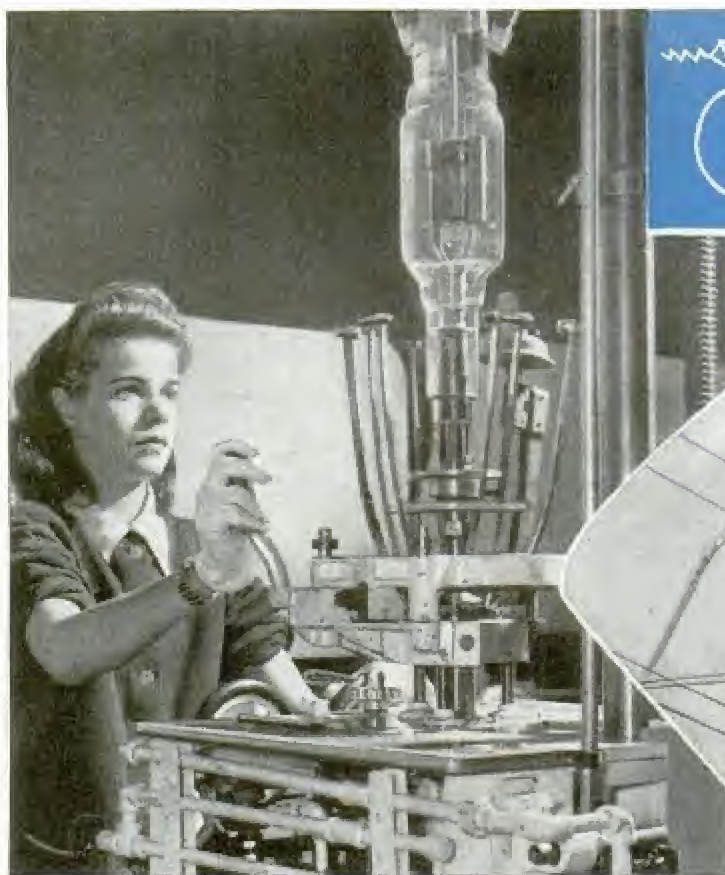
You can stump the wisest scientist by asking why an electron behaves as it does. He only knows that it does. That, theoretically, it is the smallest known subdivision of matter, a negatively charged infinitesimal something that whirls around the atom's nucleus of protons and neutrons as the planets whirl about the sun. That 30 octillion electrons weigh somewhat less



General Electric's million-volt X-ray, as easy to operate as a dentist's, penetrates eight inches of steel. Below, high-voltage rectifier tubes change alternating into direct current

Westinghouse photo





Revolving cluster of "flame throwers" seals end of transmitting tube. Below, light falling on metal releases electrons in phototube

than an ounce. That six quintillion electrons flow through the filament of a 100-watt lamp each second it is burning. Little things, aren't they?

But because smart gentlemen in research laboratories have learned how to make the electron sit up and beg, they have revolutionized industry and modern living. With tubes they amplify and rectify current, control power flow with ultra-precision, generate high-frequency alternating current, transform light into current and current into light.

The "mining" of magnesium from the ocean, the extraction of bauxite for aluminum from mud require direct current. Most of the electricity generated is alternating current. The Ignitron, Westinghouse electronic rectifying tube, came along in time to convert a gigantic stream of electrons into direct current for our wartime aluminum and steel mills, our magnesium plants, our electric railways and traction lines, and for electroplating operations possible only with direct current. Electronic rectifiers also feed the Westinghouse Precipitron, electrostatic air clearer which presages the smokeless city and



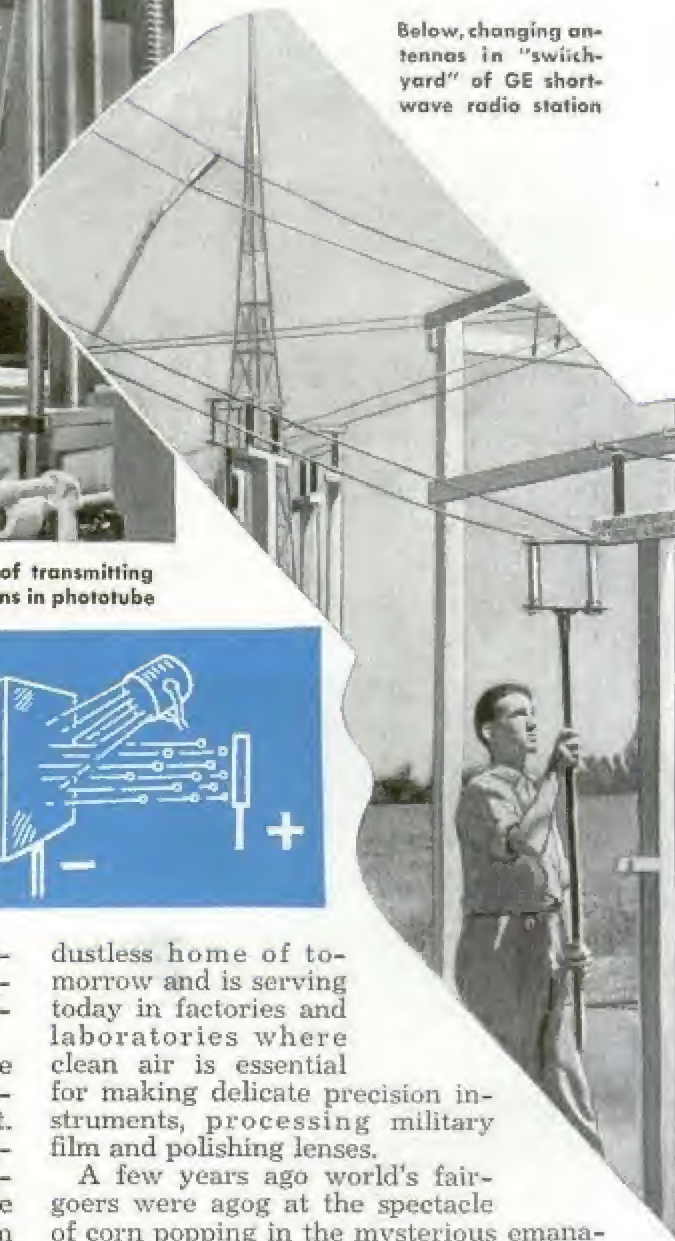
Sketch shows how energy caught by your aerial is fed into grid of electron tube and is thus amplified

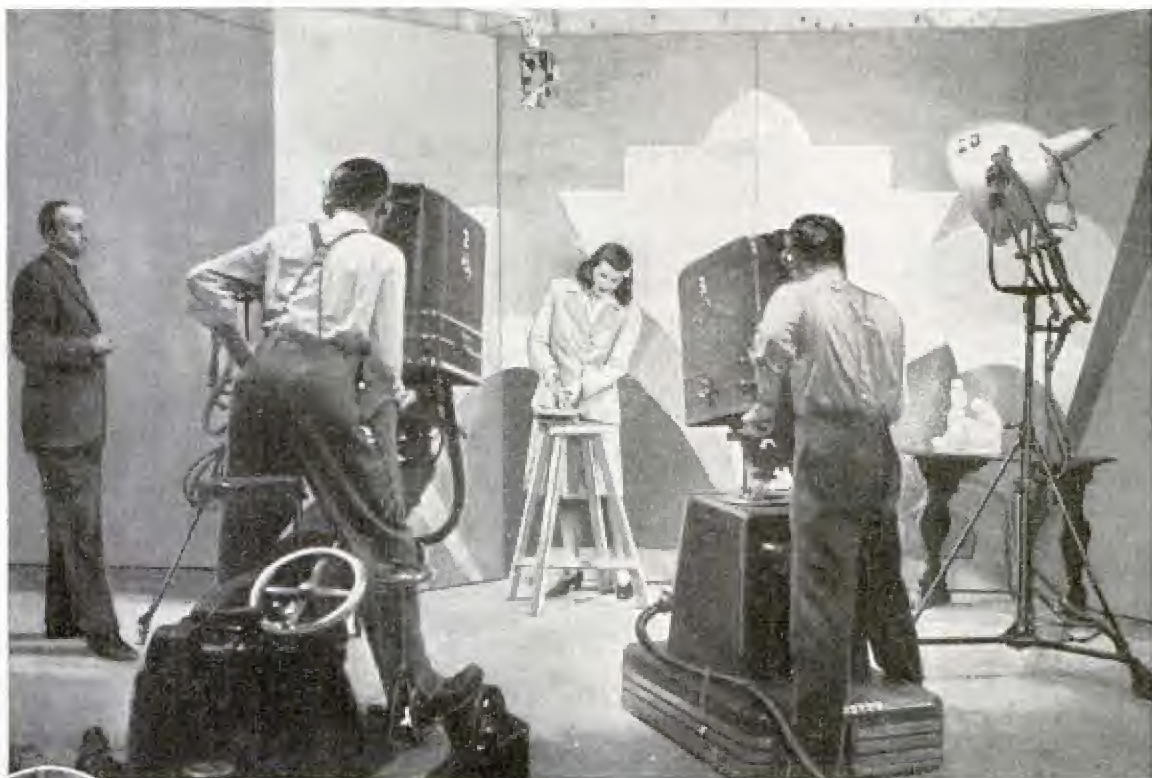
Below, changing antennas in "switchyard" of GE short-wave radio station



dustless home of tomorrow and is serving today in factories and laboratories where clean air is essential for making delicate precision instruments, processing military film and polishing lenses.

A few years ago world's fairgoers were agog at the spectacle of corn popping in the mysterious emanations of high-frequency heat. Electronic heat treatment has now progressed from the amusement stage to the industrial theater, annihilating time in bonding plywood and hardening metal surfaces, detonating explosive rivets, molding thermosetting plastics and "stitching" thermoplastics. To make it personal, a first cousin of the short-

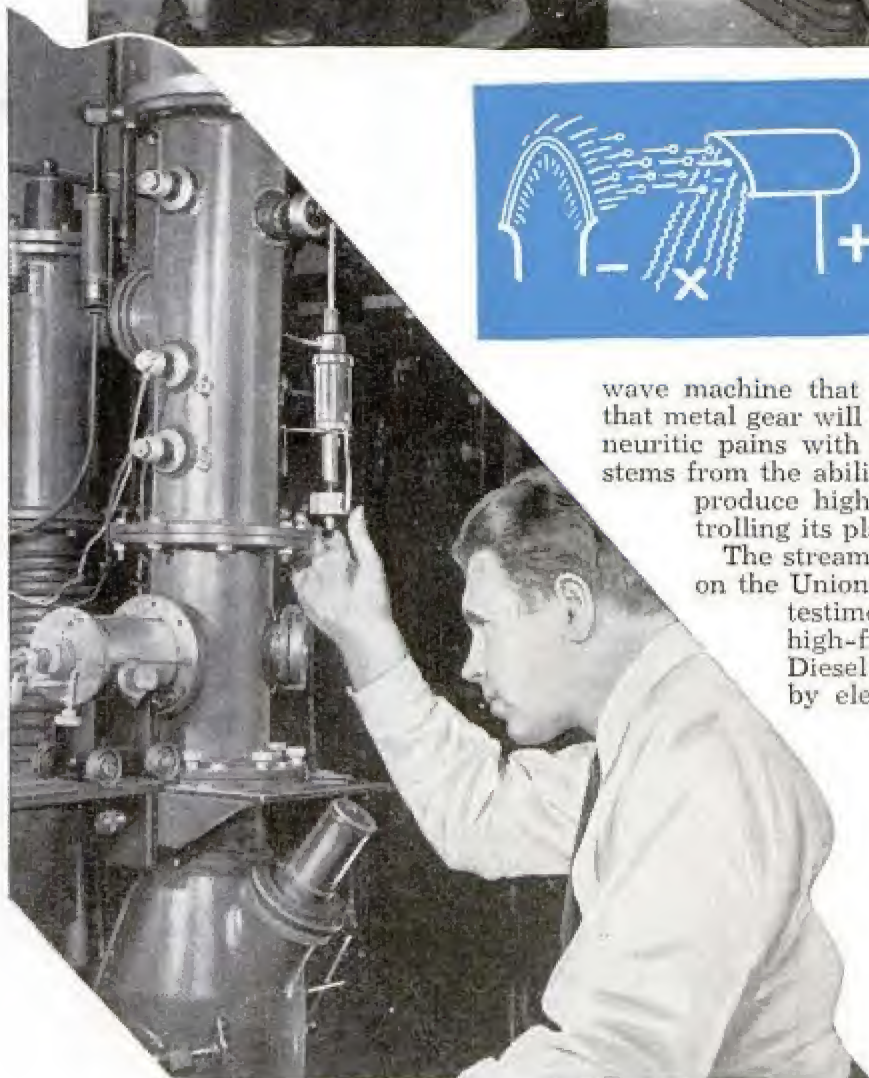




Top, sculpture demonstration goes on air from GE television station at Schenectady



At left, another schematic drawing by General Electric indicates how high-speed electrons, striking metal atoms, make these atoms give off the penetrating X-rays



Schenectady, N. Y.
wave machine that heat-hardened the skin of that metal gear will treat your ailing bones and neuritic pains with deep heat. All this magic stems from the ability of the electronic tube to produce high-frequency waves by controlling its plate current with grids.

The streamliner "City of Los Angeles" on the Union Pacific railroad will give a testimonial to the beneficence of high-frequency heat therapy. Its Diesel crankshaft was hardened by electrical induction. After a million miles of travel, inspection revealed only .001 inch of wear on the crank pins—despite the equivalent of 40 trips around the world.

A "radio sewing ma-

Studying rustproof coatings, a research man fires electronic bullets which rebound from coating, strike photographic film; film shows molecular structure of coating



Instead of hand-driven hammers, light beams striking "electric eyes" evoke music from this marimba in Westinghouse Research Laboratories

electronic tube in a control circuit that can be governed as desired by temperature, time, speed or other factors. As timer, phototube, speed gauge or pyrometer transmits its signal to the grid, the work circuit is automatically opened, closed or modified. Acting with the speed of light, responding to stimuli no human could detect, and working without any moving parts to suffer wear, the tube makes and breaks contacts, measures out exact dosages of current required by a resistance welder for high-quality, uniform welds. An electronic control may send as many as 1,800 "needles" of current per minute stabbing through aluminum aircraft parts, producing faster and stronger welds than ever.

chine" developed by RCA stitches thermoplastics together with a bond stronger than the molded synthetic material itself. A "radio pistol" firing high-frequency "nails" in a narrow beam tacks together stacked sheets of plywood with spots of penetrating heat that seals the plastic glue between the sheets. The molding cycle for shaping wooden propellers was cut from seven hours to three by induction heating. A high-frequency method of making tin plate, developed a year ago at Westinghouse, uses only a third as much war-scarce tin as conventional methods, is much faster, and saved 16,000 tons in 1943. As an indication of its versatility, electronic heating is even used to kill weevils and beetles in stored grain without harming the grain germ and the vitamin content.

Electronic magic keeps motors driving at constant speed through a varying load, oversees the melting of metals under the watchful eye of a photoelectric pyrometer focused on the furnace flames, responds instantly with corrective measures when a multicolor rotogravure press moving at 1,000 feet per minute varies by 1/1,000th of one percent from perfect color register on the printed page, detects pinhole flaws in metals and fabrics rolling from high-speed mills.

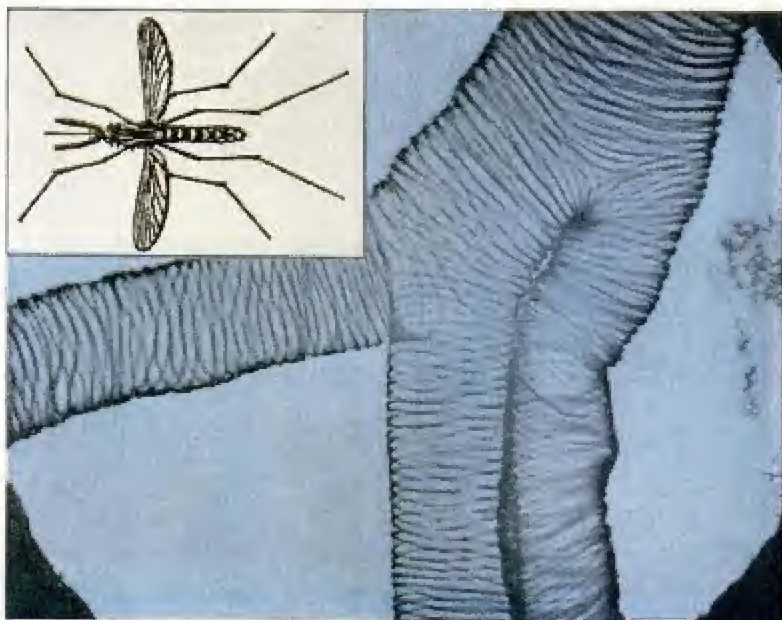
Electronic amplification carries your voice in steps across the continent over telephone lines, boosts the tiny signal transmitted from reconnaissance plane to field headquarters, magnifies tiny impulses so that engineers can study them, permits precise balancing of airplane crankshafts and propellers, giant gears and peanut-size motors.

Exact control of power in industrial processes is achieved by using the

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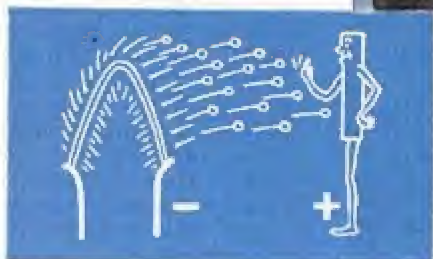
Exact control of power in industrial processes is achieved by using the

The RCA electron microscope produced this remarkable view of the windpipe of a mosquito



swell all the lights in the great auditorium in a vast, stepless crescendo. By the same principle of grid control, manufacturers govern the flow of power for delicate processes with stepless increase or decrease of direct current.

The human senses seem crude and unresponsive by contrast with the superlative responsiveness of the electronic family. A new General Electric lamp using a mercury bulb no bigger than a cigarette meters out a high-intensity flash for millionth-of-a-second photographs, delivering a less-than-momentary 4,000,000 watts of direct



The bomblike Ignitron tube produces direct current for aluminum, magnesium and other industries. Left, positive voltage attracts electrons from filament to metal plate; by changing the voltage of a grid interposed like a Venetian blind between filament and plate, flow of electrons can be increased or diminished. Below, Westinghouse high-speed X-ray tube stopped all motion, seeing through foot and ball in millionth of a second

current rectified from an ordinary 115-volt house circuit. Another portable General Electric instrument will record one-millionth of a millionth of a watt; it is used to record the human pulse beat, write high-speed records of minute changes of temperature in industrial furnaces, measure carbon monoxide in tunnels, record vibrations in buildings. An electronic "chemist" devised by a Westinghouse

(Continued to page 154)

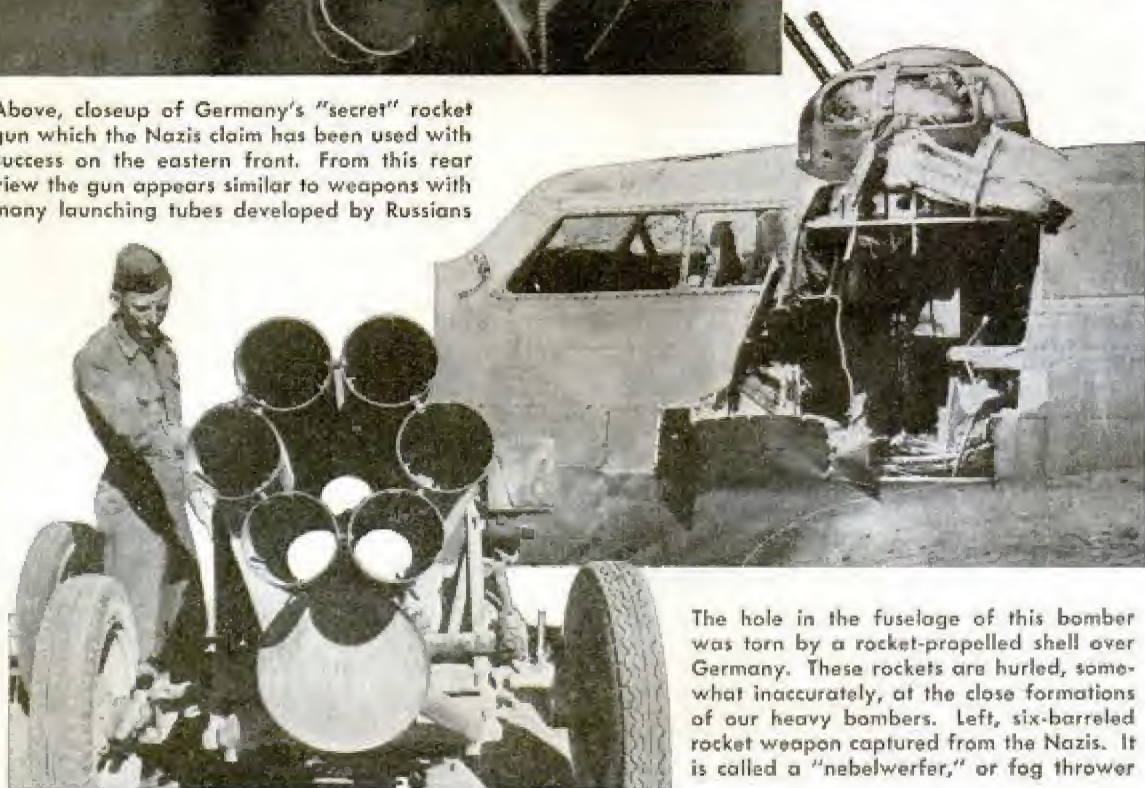


Germans Hurl Rockets From Secret Weapons



In a desperate attempt to halt the Russian armies on the eastern front and to check the destructive daylight air raids by U. S. bombers, the Nazis are resorting to rocket weapons which are said to include radio-controlled rocket glider bombs, big rocket guns set up on the coast of France to shell London, new rocket-launching devices which are attached under the wings of fighter planes, rocket throwers used by ground troops to hurl a steady stream of self-propelled shells and others. Such weapons are considered by many military experts as "propaganda weapons" rather than tools of war to subdue a hard-hitting enemy. Rockets are far less accurate than rifled guns or even a smooth-bore weapon. Also, rockets of long range must allow greater proportion of weight for the propelling charge, thus reducing the amount of explosive for demolition purposes. Ordnance men and physicists question the Nazi claim that they can launch a 12-ton rocket from France to destroy 20 square miles of area in England. More practical is the launching of rockets from planes.

Above, closeup of Germany's "secret" rocket gun which the Nazis claim has been used with success on the eastern front. From this rear view the gun appears similar to weapons with many launching tubes developed by Russians



The hole in the fuselage of this bomber was torn by a rocket-propelled shell over Germany. These rockets are hurled, somewhat inaccurately, at the close formations of our heavy bombers. Left, six-barreled rocket weapon captured from the Nazis. It is called a "nebelwerfer," or fog thrower

TENDERFOOT SKIPPER



*PC Unit #51
Naval Operating
Base
Norfolk 11, Va.*

By **Lt. John B. McLaughlin, USNR**

FOR weeks the crew of our trim little 110-foot subchaser had been training night and day in preparation for the day we'd get our "orders." First at a Texas building yard waiting for the finishing touches, then at the Navy Yard in New Orleans getting all sorts of intricate equipment installed during what is called a "fitting out" period, and finally at a Sub Chaser Training Center for a two-week "shakedown" period during which ship, crew, and officers were put through their paces. At last all of the preparation was over and I gave the order

† In wheelhouse of PC boat, officer of the deck directs movements of little sub chaser

Deadly match for warships, subs or planes, a PT boat bristles with guns and torpedoes





Official Navy photos

Sighting 20 mm. antiaircraft gun mounted on PT boat



Above, destroyer crew manning secondary (emergency) controls which duplicate those in pilot house. Men keep sharp lookout



to my chief boatswain's mate to "post the special sea detail."

In rapid succession I gave the orders, "Let go lines 1, 3 and 4 . . . hold 2 . . . starboard engine ahead . . . port engine back . . . cast off 2 . . . st'b'd engine stop . . . right 10 degrees rudder . . . all engines back . . . one long blast . . . rudder amidships."

Quietly and smoothly our "little battleship" glided out into the channel and another ship had joined the rapidly growing fleet of "sub-busters." There are four basic types of subchasers in the Navy; YP's which are the large private yachts that have been converted into fighting ships; SC's which are the 110-foot ships; PC's which are 176 feet in length; and, of course, destroyers and the new destroyer escorts.

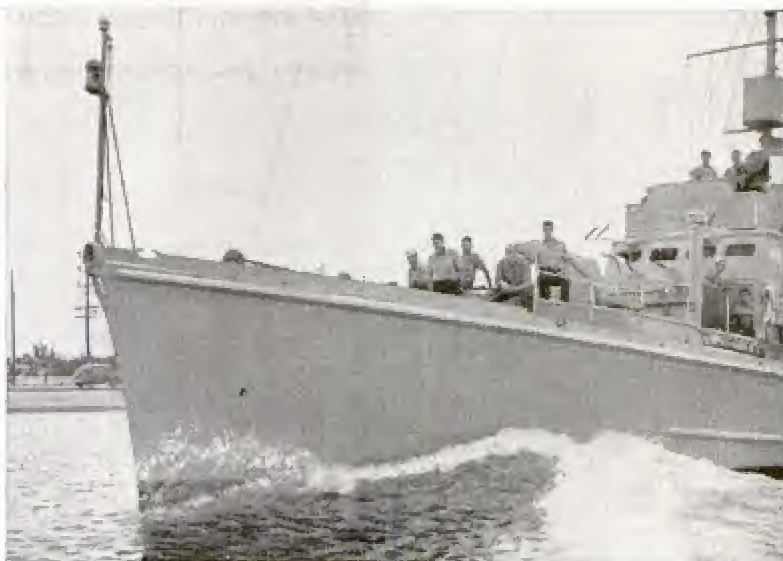
At the sea buoy we rendezvoused with two other subchasers that were to accompany us to the port named in our orders. After much signaling between the ships by "blinker" (a searchlight used for signaling) the speed, initial course, and formation were set and we were on our way. This was my first long trip as "skipper."

Since entering the service, I had been taught navigation, gunnery, seamanship, tactics, communication, and Navy Regulations for eight long weeks at the Navy Training School at Boston, been through five weeks of training in antisubmarine warfare at SCTC (Sub Chaser Training Center), and two weeks at the Fleet Sound School learning the rudiments of submarine sound detecting equipment.

Prior to that I was a happy suburbanite rushing to catch the 8:10 train every morning to my job in the advertising department of a large oil company in Chicago. Now in a little less than six months I found myself on the high seas as captain of a fighting ship. My executive officer was a young architect from Houston, Texas, and my junior officer came from the campus of Boston College. Our training was typical of that given to hundreds of other men from civilian life who were already, or were soon to become, officers in our sub-chaser fleet.

Although we were just sailing out on our first assignment and hadn't as yet even seen the enemy, we already had a deep hatred for him. From some of the members of our crew who had been torpedoed, and from conversations with fellow-students at SCTC who were back for a "refresher course" after months at sea, we had heard tales of Axis subs that made us itch to get at 'em. We remembered a battered lifeboat at SCTC filled with sixty bullet holes. It was brought in by a rescue ship with the bodies of sixteen machine-gunned American sailors.

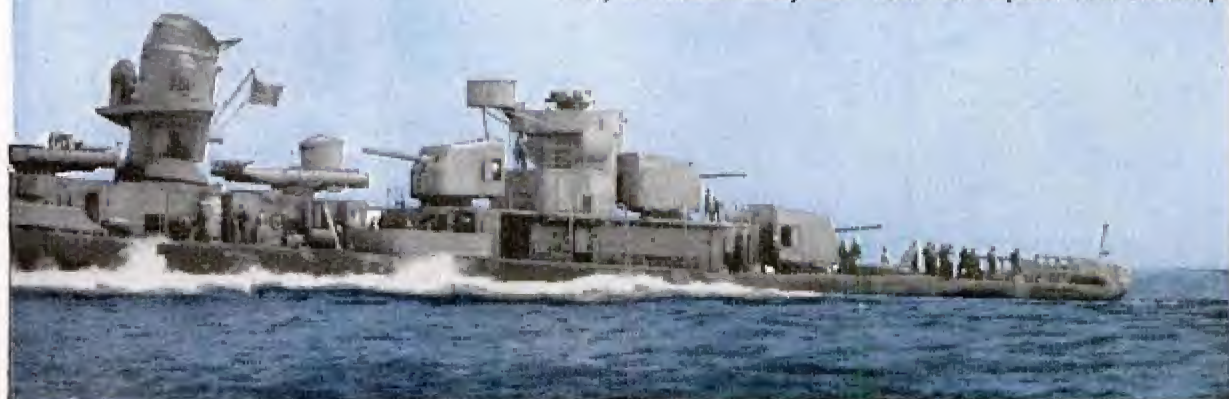
As we took our departure from the sea buoy I "secured" the special sea detail and ordered the "chief" (chief boatswain's mate) to post the watch. On an SC the



Cruising near Navy's Submarine Chaser Training Center, this speedy 110-foot SC boat carries depth charges and powerful guns



Ready to let go with a depth charge, Coast Guardsman awaits order to fire. Below, camouflaged destroyer, the USS Nicholas, ready to combat enemy craft. Note the torpedo tubes amidships





Winding up magazine of 20 mm. gun to force shells into breech

crew is divided into two watches, port watch and starboard watch. Half the men are on duty for four hours while the other half rests. This is called standing a "Watch and Watch." It's a tough grind on a crew but sufficient battle stations are manned to be able to make an immediate attack on a submarine. Unless we had to make what is called an "urgent" attack, however, we

usually sounded the general alarm and called the entire crew to man battle stations. When all battle stations are manned it is called "General Quarters." On our little ship we finally got to the point where every man would be at his station within 26 seconds after the General Quarters siren had been sounded. Why the speed? Because a sub can crash dive in from 30 to 40 seconds.

During the first few days of our trip the sea was like glass, the weather was perfect, and the men slipped into the routine like old hands. On our second night out we had our first bit of excitement. At about 0100 (which is the Navy way of saying 1 a.m.) the O.D. (officer of the deck) called me in the wardroom on the phone and reported that the crow's-nest lookout had just sighted a steady white light on our starboard bow. As you know, during wartimes, ships cruise at night without a trace of light showing, and so the only conclusion the O.D. could make was that this must be a navigational light or lighthouse, even though he knew we were supposed to be many miles away from land.

Up the ladder to the bridge I went on the "double" and as I studied the light through glasses (binoculars) the first thought that struck my mind was: "Lord—is my navigation that lousy?" But after studying the light, checking our course, and scanning the charts, I knew it couldn't be a lighthouse. And it wasn't. In a short time the

lookout reported "Now there are two steady, white lights." Then over the phones came, "Sir, it looks like a Christmas tree, now." Sure enough, as we drew closer, there was a strange sight for sailors to see nowadays—a fully lighted liner. It looked like a peacetime cruise ship to our startled eyes. The O.T.C. (Officer in Technical Command of two or more ships) who was on one of the PC's with us, decided not to investigate, and so our "cruise ship" passed us by in the night. Later we learned it was an Argen-



Submarine fighters manning fast Diesel-powered PC boat



Aerial cameraman catches PC boats in practice run dropping depth charges which toss spray high into air

tine ship and that was the way they cruised at night to let any curious subs know they were "neutral." Once in a while they'd sail close to darkened convoys which made skippers angry enough to shoot.

The next day we had our first sample of rough seas. Our 110-foot ship pitched and tossed, and great waves broke clear over the masthead enveloping the SC in one sheet of green after another. She keeled over from side to side oftentimes as much as 45 degrees. Keeping our footing was a tough job, sleep became impossible, and eating became an art. By nightfall nearly half the crew was manning the rails sicker than most of them had ever been in their lives. I've read several magazine stories about how Corvettes and PC's were the "roughest things afloat" but I'll guarantee the guys who wrote those stories have never been on an SC in a heavy sea.

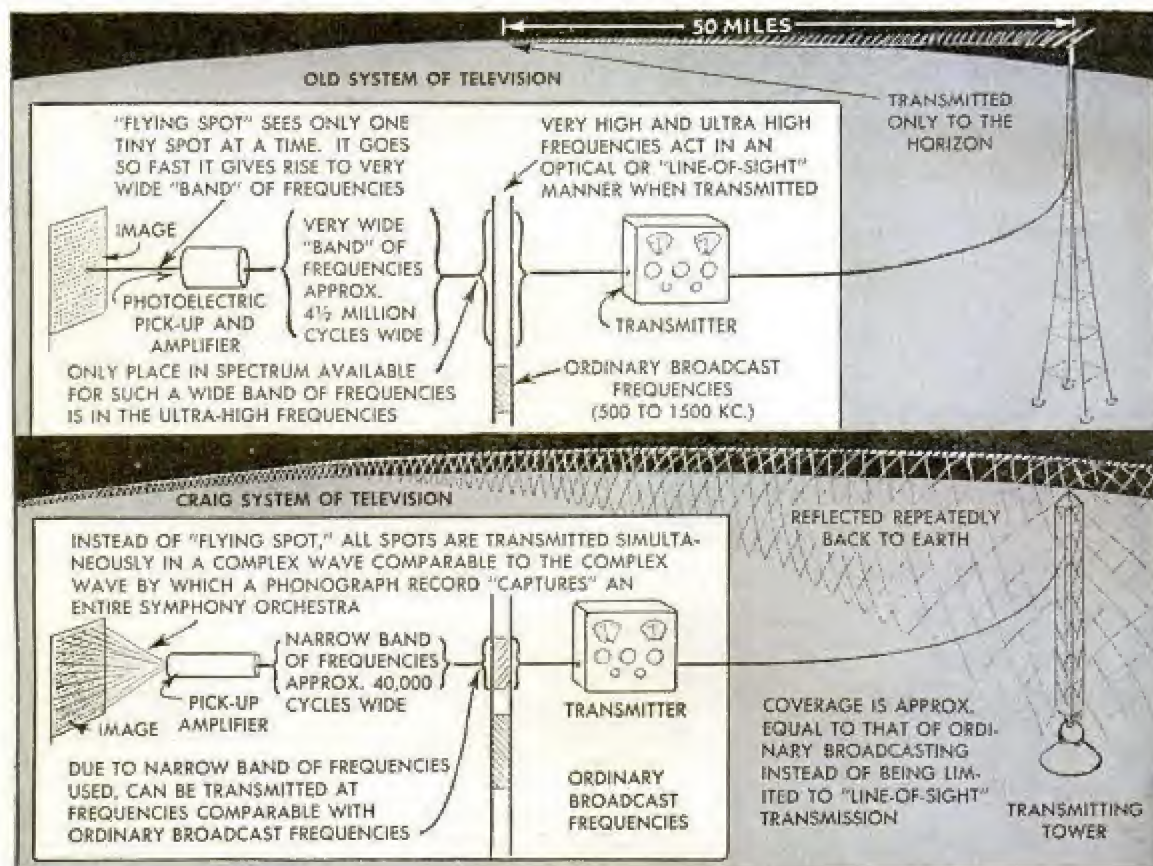
PT boat gunner operating twin .50-caliber antiaircraft guns



The following noon, we heard the crow's nest lookout sing out "Land Ho—dead ahead." Shortly we reached a sea buoy and saw a long line of mine sweepers coming toward us as they swept the approaches to the port. We docked at the sub-base, made our arrival reports, and cared for the

(Continued to page 156)

Limitless Horizon Is Foreseen for Television



Fetters that have limited the development of television may be shaken off by a new broadcasting technique that promises to revolutionize the industry while still in its infancy. Not yet given a full-scale trial but proved in laboratory experiments to the satisfaction of its inventor, the system would make possible limitless broadcasting at far less cost than the present transmitting method, which reaches receivers only within about 50 miles, and it would also obviate the present necessity for intense lighting of the scene at the television pick-up. The inventor is Dr. Palmer H. Craig, head of the Department of Electrical Engineering at the University of Florida, electronics inventor who has worked with television for 15 years. Existing television cameras scan the entire image — taking some 240,000 separate impressions in $\frac{1}{30}$ second, in sequence, thus requiring an intense light. The transmitter broadcasts only to the visible horizon, using a wide band of frequencies and so being restricted to high-frequency wavelengths. Dr. Craig would substitute for the high-speed sequence scanner a complex arrangement of 240,000 electronic "pick-up" loops which would record simultaneously 240,000 divisions of the image.

"Each elementary area of the photosensitive screen," says Dr. Craig, "will have its corresponding voltage of definite frequency induced in the loop system. If these loops are all connected in series there will result a complex voltage wave containing all the frequencies and amplitudes corresponding to all the elementary areas of the photosensitive screen, therefore characteristic of the incident light."

Little power would be needed to broadcast the multiple image on a narrow wave band, and the signals would be unscrambled by the receiver to reconstruct the image—the amplitude of the wave determining the intensity of the light, the frequency determining the position of each area in the reconstructed image.

Plastic "Shaving Cream" for Pig

More high grade pork products are assured with a plastic covering that removes all the hairs from a pig when it is peeled off. The chemical shave, accomplished with a resin produced by the Hercules Powder Company, not only removes the toughest whiskers but saves valuable time. The pork carcass can be painted or dipped, and the resin chemical is remelted and used over.



Largest Glider of U. S. Air Force Is Ready for Invasion 77936

When American glider-borne troops make their silent approach to enemy territory, they may be riding in the Army Air Force's largest glider. This craft, built by the Northwestern Aeronautical Corpor-

ation, was recently given official tests. The company was given the "go ahead" signal to build many gliders of this type. Details of construction and the number of fully-equipped troops it will carry are secret.

Test for Big Guns 77961 Uses Air Device In Lieu of Firing

Five-inch naval guns are tested without firing a shot by means of an air compressor that duplicates conditions resulting from actually discharging the guns. The kick, rammer, and firing are tested with the device which was developed by engineers at the Fisher Body Pontiac Division of General Motors where the big guns are assembled. Use of the compressor not only saves time, but conserves much valuable ammunition.



Detroit, Mich.

210-Foot Bridge Is Taken for a Barge Ride to Train Army Engineers 77954

When army engineers at Camp Ellis, Ill., needed a steel bridge for training purposes, they floated an old 210-foot span 60 miles down the Illinois River to their camp site. The bridge was mounted on two barges, and the engineer "tars" pitched their tents

aboard for the trip to camp. Trainees will learn the technique of bridge-building by taking the bridge apart and reconstructing it over and over. When they are through with it, about 80 tons of steel will be turned over to the scrap metal drive.



Acme Newspictures, Inc.

The CAMERA CLICKS for UNCLE SAM

*Mr. Warren Allen Elliott
7 Park Avenue
N. Y. 16, N. Y.*



Pratt Institute photo

This camouflage model will reveal defects to camera hidden from the human eye. Below, Westinghouse employee using new type camera to take badge photo



ONE of the strangest photographic exhibitions in history was opened not long ago by the U. S. Navy.

The scene was the Norfolk Navy Yard. A sleek destroyer escort had just been finished and okayed. It was the first of a new type. It was a beauty.

At a given command, a group of photographers swarmed over and throughout the ship shooting hundreds of pictures. Thousands of prints were rushed out of dark-rooms on large rectangles of heavy paper.

The photographs didn't show the graceful symmetry of the little warship, nor were they hung on walls to be judged for composition values.

They showed the innermost, secret and complex details of the construction of the vessel and they were distributed in sets of a couple of hundred each to a long line of ways where the frames of a large number of destroyer escorts, duplicates of the first, were being put together. Each durable, weatherproof photo was placed as near as possible to the section of the craft which was shown in the picture.

Thousands of workmen, many of them inexperienced, gathered in knots along the assembly line studying the prints. Most of them couldn't read a blueprint, but all could glean information from a photo.

To a man, they began to see how each

POPULAR MECHANICS

trim craft would be put together. Each worker visualized his part in the operation. Cheers went up. Backs were slapped. Hammers began to pound. Welding arcs sputtered. Enthusiasm grew.

The camera had clicked once more for Uncle Sam in this increasingly scientific and complicated war. The new system of "true-life" blueprints is spreading to all shipyards where mass production with unskilled labor is possible.

Millionth-of-second speed light cameras reveal how water flows from a faucet
Courtesy General Electric Co.



The scene changes to a gigantic Ford Company war plant. The camera is wearing overalls, instead of navy dungarees. A squat, grim tank—a new model dedicated to deadliness—rolls into a room where lights pour on it from all angles. The usual drab coat of camouflage is replaced with bright photogenic colors. Movie cameras whir, still cameras click as mechanics go to work on the tank, take it apart section by section and put it together again.

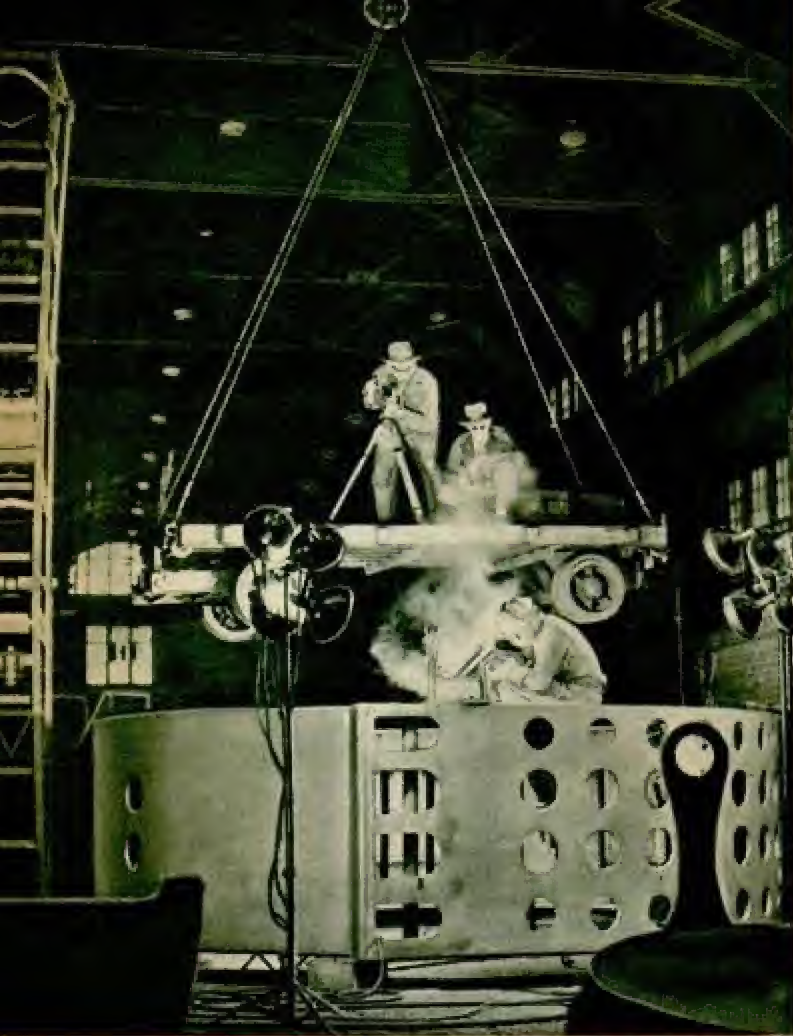
Once more film is developed and prints are made. Sets of the prints are not only used in the tank assembly line, but flown all over the world to spots where American tank crews and mechanics will have a chance to study the secrets of the new vehicle before it arrives for action.

APRIL, 1944



Taking a picture with the first million-volt X-ray camera developed by General Electric. Below, photographing assembly of a new tank





On platform suspended from crane, Hollywood cameraman record "The Inside of Arc Welding." Below, slit in edge of wheel allows $1/10,000$ second for filming an electric arc Westinghouse photo

In a General Motors plant, the camera comes through with another startling war-born innovation for Uncle Sam. This time it is an X-ray camera producing "cold glow" photographs with light similar to that of the firefly and using blueprints made of steel. These eliminate errors caused by shrinkage of blueprint paper, and avoid misfits in plane parts manufactured at far-separated points.

A white surface is painted on a sheet of steel one-sixteenth of an inch thick. On this, the design for an airplane part is drawn to exact size with a chemical that can be activated by X-rays. A shot of X-rays causes the

pattern to glow. The sheet of steel is placed on another which will form the pattern. A coating of photographic emulsion on the second sheet of steel is affected by the glow, just like an ordinary photographic print. Thus the design is transferred. The completed patterns are shipped to plants where plane parts are cut.

The huge General Electric plants have moving picture studios rivaling some in Hollywood, and one of their specialties is the production of training films which enable armies of new war workers to march on the job with quickly acquired mass-education provided by the camera.

More than 700,000 separate photographic prints are made each year in the many buildings of this company, and its file of negatives is well along toward the million mark.

Photographs with an exposure of one millionth of a second, brief enough to stop a rifle bullet or any fast moving object, can now be made by an electronic light equipment developed by engineers in General Electric's laboratory. This device, using a small mercury lamp no bigger than a cigarette, consists of a small portable box, 10 inches square and weighing less than 20 pounds. The mercury lamp would last the ordinary newspaper photographer 500 years if he could live that long, for it is good for 1,000,000



exposures. Just now it is working entirely for the war effort.

Westinghouse is a pioneer in the use of the camera for industrial research by big corporations. Some of the results have not only speeded up the victory tempo for Uncle Sam, but will help make possible less expensive and more efficient homes, automobiles, airplanes, furniture and other items in the postwar period.

One Westinghouse camera development makes slow-motion pictures showing the actions of atoms of steel as a piece of metal is placed under strain by being pulled with hydraulic pressure. Metallurgists get a new idea of what happens when metals are undergoing great stress as in forging processes.

Another Westinghouse camera, minus shutter, but using a flash of ten millionths of a second, has been rigged up to study the true character and actions of droplets of liq-

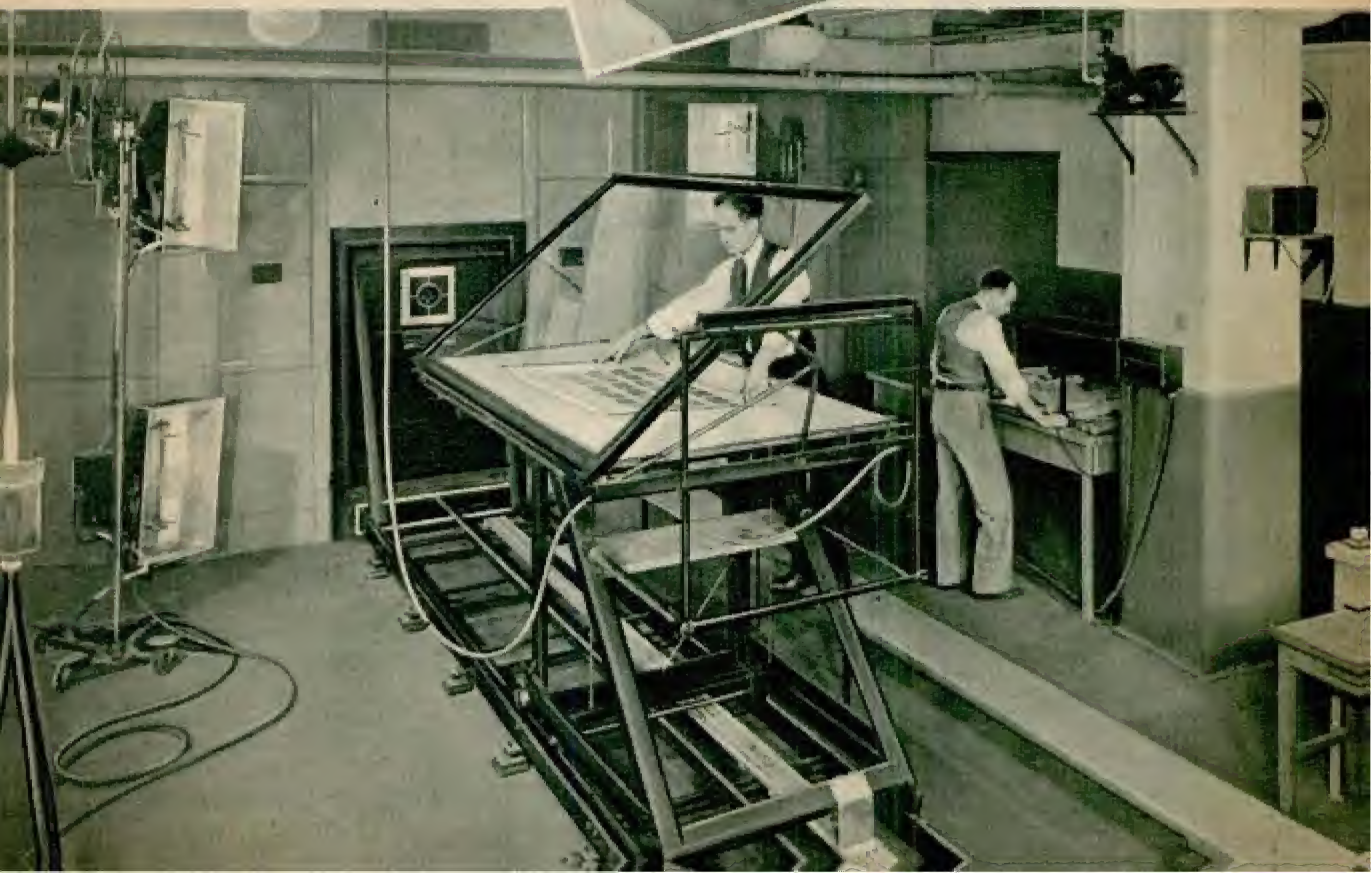


Above, crew of cameramen making a General Electric motion picture on use of electron microscope



Left, steel disk is clamped between two sheets of film, then shut up in "tin can camera" for exposure Westinghouse photo

Below, part of giant camera which occupies two rooms, has four-man crew, and turns out 6-foot films Courtesy Bell Telephone Laboratories





Westinghouse photo
Spectrograph identifies elements of unknown materials on film which records light rays sorted by a prism

uid in sprays. The applications may serve to make your postwar automobile or plane motor operate more efficiently.

A makeshift camera constructed of a tin can, without lens, shutter or any of the usual gadgets, enables the company's scientists to study the actions of phosphorus in steel. Steel disks to be investigated are clamped between sheets of photographic film and brass plates, dropped into the can

where by the emanations of the phosphorus itself, photos are produced solving puzzles of years' standing.

A special wheel equipped with a slit which speeds past a Westinghouse camera lens in one ten-thousandth of a second takes pictures of electric arcs. Another automatic Westinghouse camera, operated with a battery, makes photos of lightning flashes as they hit power lines, using the juice of lightning itself to start the camera working. The "criminal" bolt of lightning is made to take its own rogue's gallery portrait to be studied later by scientific detectives in the corporation's laboratories.

A complicated camera of the underwater type, put together by Westinghouse engineers, enabled the lens to see inside of an oil circuit breaker, making films which showed that electric arcs performed "bubble dances" inside gas particles formed in the oil switches by the action of the current. More efficient circuit breakers have been made because of these movies, snapped at the rate of 2,000 exposures a second.

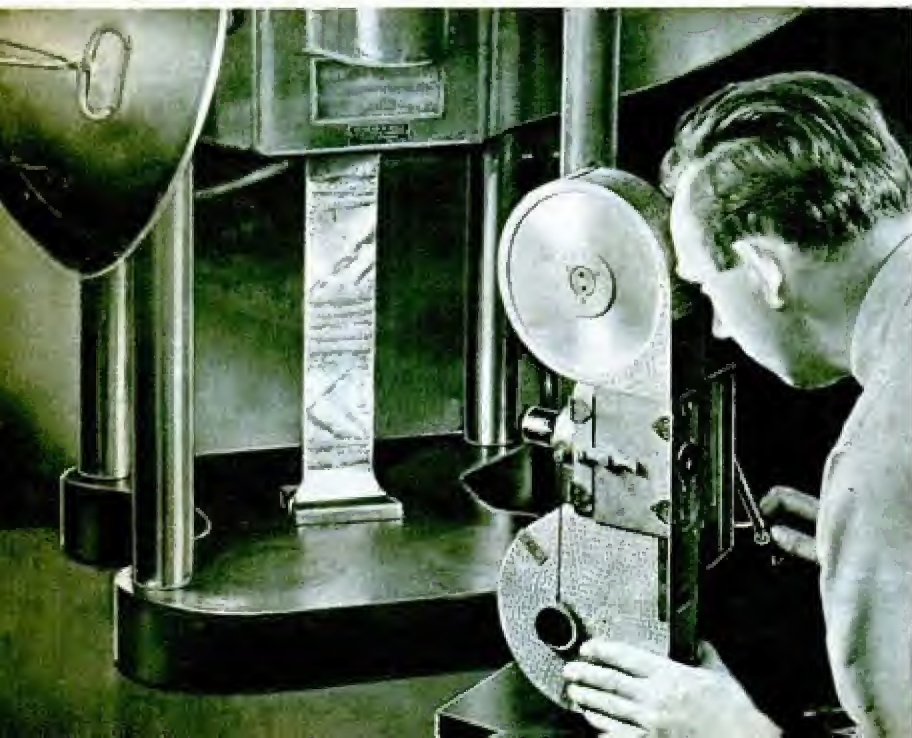
Making X-rays was speeded up to one millionth of a second by Westinghouse research, enabling this type of camera to probe the secrets of machines whirling at tremendous speeds. One "skeleton" photo of a man shaving himself easily stopped the vibrations of an electric shaver for scientific study.

By using a polarized-light camera to take pictures of the inside of plastic models of turbine nuts and bolts, a Westinghouse engineer has discovered how to make this ancient fastening device 40 percent stronger. He found that nuts with broad shoulders and tapered bodies distribute stress on threads more evenly than does the ordinary nut. In his experiments, the engineer made various types of nuts and bolts, attached weights to the bottom of each model and then heated them to "freeze" the stress lines. Cutting slices from the center of each model, he photographed the thin plastic sections. The pictures revealed which nut divided the "pull" among threads.

Cameras of one type or another are testing steel used in tanks, ships and guns, seeking flaws in completed metal parts,

(Continued to page 148)

Westinghouse photo
Making movie of lines formed by the movement of atoms





*Canadian Car and Foundry Co., Ltd.
Montreal, Quebec, Canada*

"Ice Box" on Wings Loads Containers In "Bomb Bay"

Powered by four 5,200-horsepower engines, flying wings in the postwar era may haul fresh fruit from Florida to Canada. A 120-ton flying wing cargo plane, designed by Vincent Bernelli for Colonial Airlines, would deliver the fruit in Montreal just 14 hours after it was picked. With a 210-foot wing span and a 71-foot body, the refrigerated express plane will carry enough gas to make a nonstop flight of 1,600 miles with a 40-ton payload. The plane is expected to revolutionize the handling of air cargo by rapid loading of pre-packed 5,000-pound containers. The containers will be lifted



into the flying wing by apparatus similar to that now used to load "block busters" through the bomb bays. It will be possible for the plane to tow one or more flying wing gliders for dropping additional cargo at intermediate points along the route without interrupting its flight. Glider plans, however, await future technical developments, according to the inventor.

Cadet "Dunker" Teaches Pilots To Quit Ship

Made from a sawed-off two-seater training plane, the "Dilbert Dunker" helps train cadets to escape from a plane forced down at sea. Future pilots are hoisted aloft in the dunker, and then lowered into the water. The dunker quickly sinks as fully clothed cadets scramble out, inflate their life raft, and climb aboard the rubber boat. "Dilbert" comes from the name given cadets who are always doing something wrong.



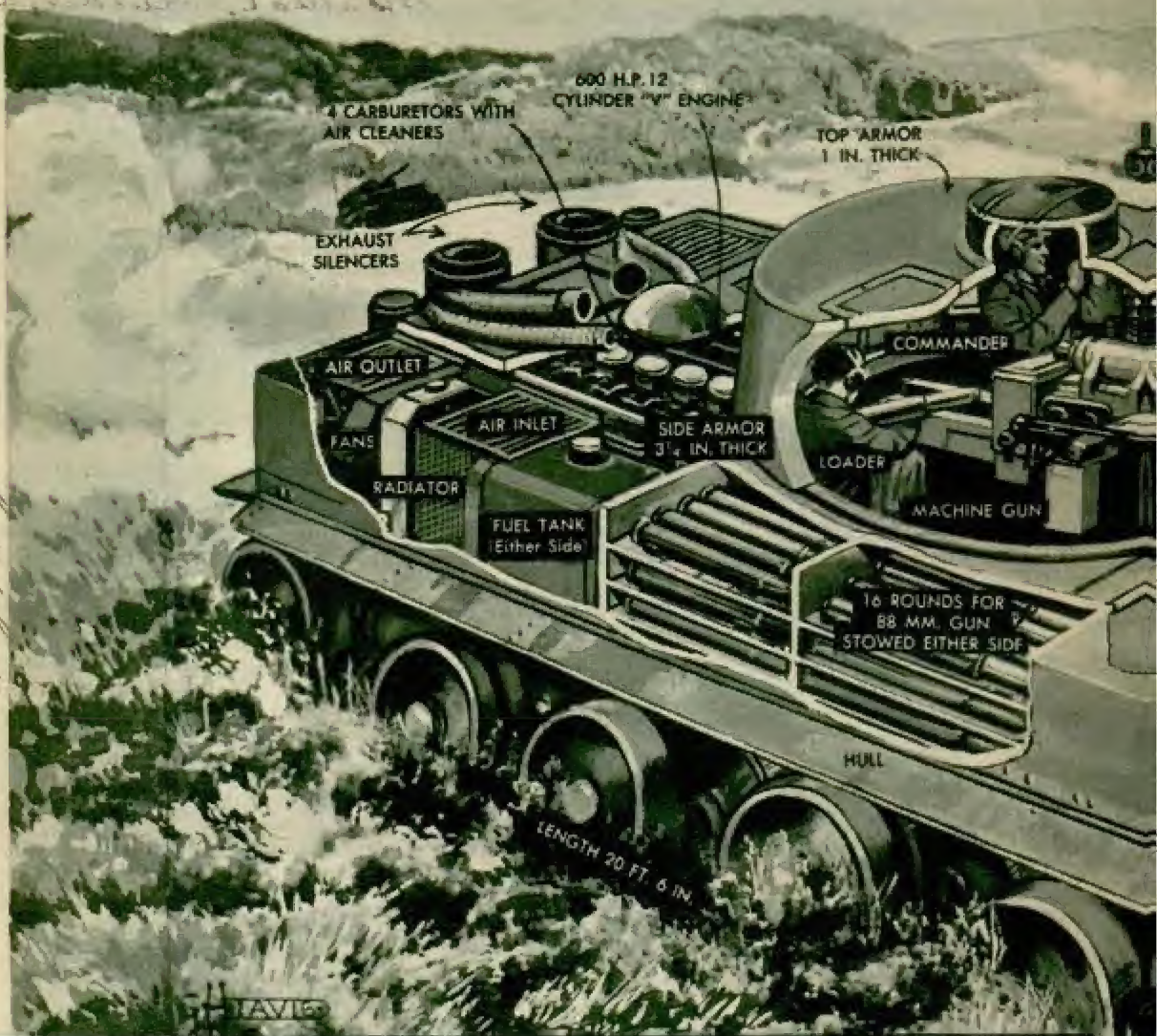
APRIL, 1944

*Tested at Naval Air Training Center
Corpus Christi, Texas*

Monster Tank Can Cross a River 15 Feet Deep

Allied guns in Africa and on the Russian front shattered the myth of invincibility of the German Mark VI "Tiger" tank long before the secrets of this 56-ton monster were revealed. The main armament of this cumbersome "fortress on tracks" is an 88-mm. gun which fires shells three feet long. The gun has a special mounting and is fitted with a special muzzle brake to reduce recoil. Rate of fire is slow due to the difficulties in handling the big shells which are

stored in horizontal bins. Additional fire-power is afforded by two 7.92-mm. machine guns. A watertight compartment for the engine at the rear, rubber seals fitted to all the main openings, and air intakes that have telescopic extensions enable the tank to cross rivers 15 feet deep. The "Tiger" is operated by a five-man crew, has a top speed of 17 miles per hour, and a cruising radius of about 75 miles. Lack of maneuverability makes the tank an easy target.

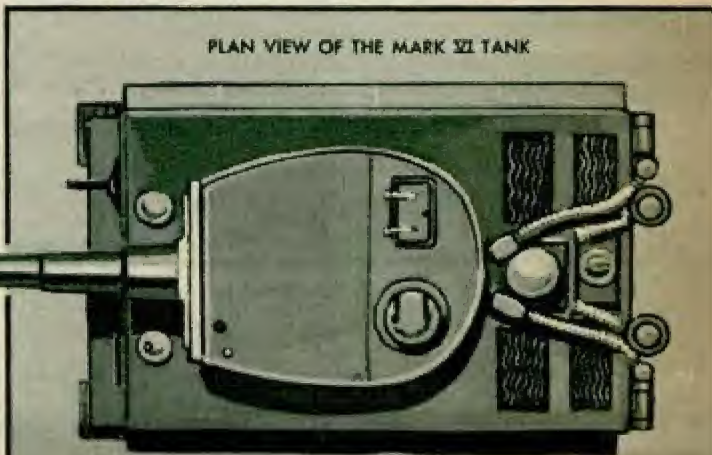
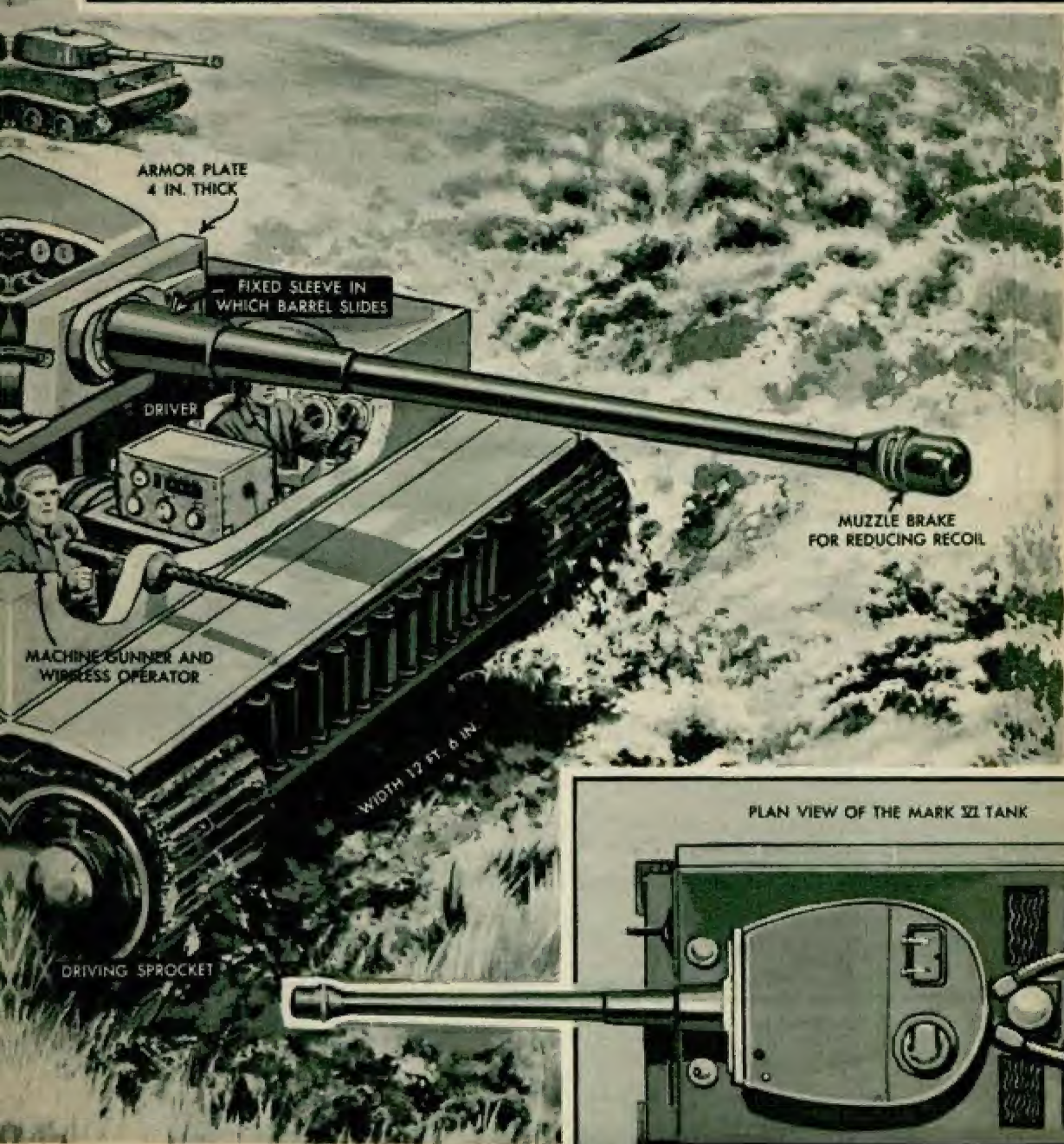
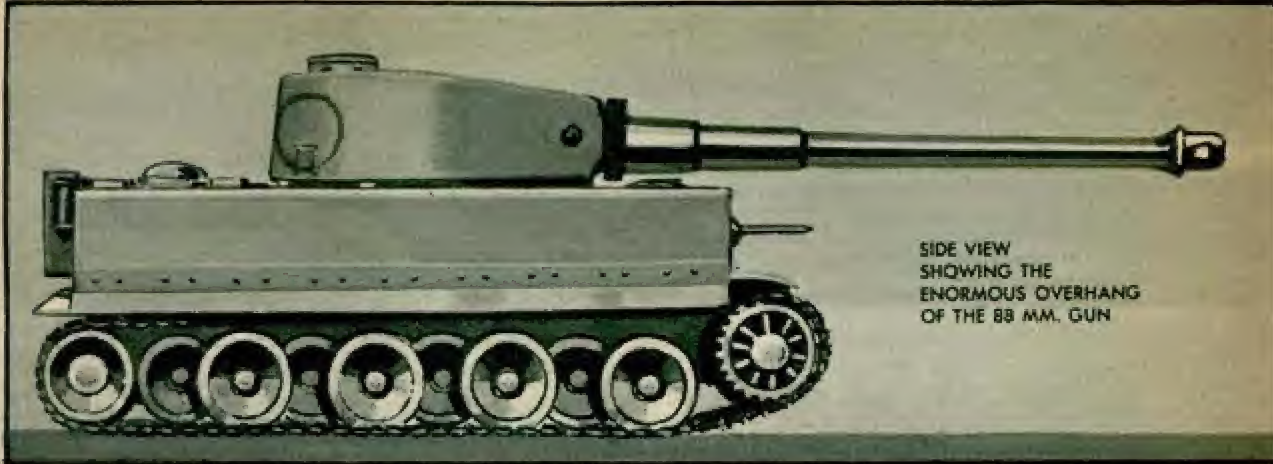


THE GERMAN "TIGER" TANK IS CAPABLE OF BEING MADE WATERTIGHT AND CROSSING RIVERS, ON THE RIVER BED, TO A DEPTH UP TO 15 FEET



*International News Photo
235 C. 4024 H
77939, 7794*

German "Tiger" Fires Shell Three Feet Long



*Pittsburgh Plate Glass Co.
Great Bldg., Pittsburgh 911*

Coal Chutes Made of Glass Last Longer Than Metal



Comparing glass and steel chutes after friction test

To save strategic metal, glass is being used to make coal chutes which have been found to wear longer than steel plates. Coal wears out steel plates in three months due to the action of sulphur water and constant friction. Under actual working conditions in a coal breaker handling a daily load of 100 tons, glass chutes showed little wear after 18 months. Because it is easy to clean, it is expected that glass will also be used in chutes and conveyors designed to handle foods and other products.

U. S. Railroads Top All Records For Transportation in '43

With fewer locomotives and freight cars than in 1918 and many thousands of miles less track, the American railroads in 1943 handled the greatest volume of freight and passenger traffic in history and broke every transportation record existing. Measured in tons carried per mile, freight traffic gained 14 percent over 1942 to total 725,-

42 "Railway Age"

Dec. issue, '43

000,000,000 ton-miles, one and three-quarters times the volume in 1918. Passenger-miles totaled 85 billion, 58 percent above 1942 and twice the 1918 figure. Ten million servicemen traveled in special trains or special cars, besides the millions on regular trains. The average load of freight per train was 1,116 tons. The average capacity of freight cars reached 50.8 tons, and the average load per car of carload freight was 41 tons. The average daily movement of freight cars was 51.2 miles, compared with 48.8 in 1942. Locomotives, too, set new high records for performance; freight engines averaged 125 miles a day, compared with 122.4 miles a year ago; passenger locomotives traveled 220.3 miles on the average, compared with 206.8 miles daily in 1942. Their tractive power averaged 52,548 pounds, the highest ever achieved and 34 percent more powerful than 20 years ago.

Work Stand for Plane Mechanic Adjusts to Desired Level

Servicemen can work at a convenient level on wings or fuselage with an adjustable extension work stand. Adjustment is made with a hydraulic strut actuated by a hand operated hydraulic pump. The mobile stand is made of tubular steel, and can support 1,500 pounds.

*Pacific Engineering Corp.
3123 San Fernando Rd.
Los Angeles 41, Calif.*



Tubular steel stand aids mechanics working on plane

POPULAR MECHANICS

71924

Painting Tool for Wire Coats 10 Feet a Minute

Telephone wires that extend from poles to buildings are quickly recoated with a painting tool which is pulled along the wires. The tool, developed in the laboratories of the Bell Telephone Company, is a trough-shaped container with a guide pin and stiff brushes at one end. The pin keeps the wire immersed in the paint and the brushes remove the excess. The painter is drawn along the wire about 10 feet per minute to insure adequate penetration of the braid.

Newark, N. J.

Tool with trough-shaped container is pulled along wire. Insets show how brushes remove excess paint



71130

Midget Model of Tractor Has Caterpillar Tread

Built in a home work shop, a small Caterpillar-type tractor operates like the real thing and can pull loads up to 200 pounds. It is powered by a three-fourths horsepower engine. The tractor is 27 inches high, 26 inches wide, 48 inches long, and weighs 240 pounds. Steering is accomplished by two six-inch cone clutches and brakes on the rear axle that are controlled by levers just as in a real tractor. The controls also include a choke, throttle and "cut-out" switch. Robert C. Cross, of Woodland, Calif., built the tractor for his small son. The cost was approximately \$125.

71962

507 Main St.

Voice Heard for 18 Miles Projected by Mobile Unit

Alarm signals, voice or music can be heard for a distance of 18 miles with a sound amplifying system mounted on a trailer. Despite the range of this system, there is said to be no distortion of sound for persons standing within a few feet of the unit. Some of its military and civilian uses include signaling planes at airports, directing soldiers and sailors in battle, and as an air raid signal. The outfit has its own built-in power plant and can be set up ready for operation in a few minutes.

APRIL, 1944



Bendix-Westinghouse Auto-motive Air Brake Co. Colyria, Ohio

Thomas C. Shannon, Jr. 11 897
2872 Franklin Ave.
Los Angeles 27, Calif.

DRESS REHEARSAL for WAR



While "sniper" bullets whistle overhead, soldiers dash over barricade past "dead" man in German uniform

JOHNNY G. I. was no raw recruit the first time he faced enemy guns.

He had become a battle veteran long before.

He had been shot at by snipers and had been dive-bombed by aircraft in a combat tryout that was part of his training. He already knew what it was like to crawl along the ground under the whistling death of machine gun bullets. Crouched in a fox-hole, he had been run over by ponderous tanks. All this was part of a mental conditioning program designed to give him the confidence of a seasoned soldier.

The rehearsal that he went through wasn't a game. The machine gun bullets passed uncomfortably close to his head. The land mines that exploded in his path showered him with dirt and debris. The sniper's carefully aimed bullets came within a few inches of killing him and the sniper kept up his fire until Johnny G. I. took cover.

The American doughboy's profession is that of a killer. He is taught, with all the science and skill that his officers have, to find the enemy and kill him, and to avoid being killed while doing it. Part of that training is to condition him against the shocks and realities of modern combat. All infantry replacements and all new units are getting this battle practice; men already abroad are given it whenever possible. Even Army nurses are learning what it's like to be under fire.

At Camp Roberts in California there's a "French Village" of some 20 houses, complete to rough furnishings, that is a nightmare of land mines, barking machine guns, booby traps, and pop-up targets that you must put bullets through as you run past. The village has been captured 500 times or more in training, and it's beginning to look it. Its walls are torn by bullets, its windows are shattered, and its streets have been ripped up by explosions. It is an out-

door classroom in which the technique of village fighting is taught.

You are issued live ammunition and are told frankly what to expect. "Keep under cover and fight from house to house!" the instructor yells. "The streets are being raked by machine gun fire and those guns don't have safety stops on them. Some of you men may get killed. Simulate throwing a hand grenade inside before entering a house, and fire at every target you see! Let's go!"

The group, in extended order, starts out on the run, guns at high port for instant use. Suddenly the mighty concussion of a land mine lets go at one side and the earth shakes. The men keep going. They have entered the houses on each side of the street now and some of them are working along the roofs, keeping low to avoid possible sniper's bullets.

At the corner of a house the cardboard outline of a helmeted head suddenly pops up, pulled by a wire in an instructor's hand. "Wham!" One of the men puts a bullet through the target. By now the firing is general. The men inside the houses, racing upstairs and from room to room, encounter other targets that pop up from behind barricaded beds or tables. They fire a round at each. Occasionally a sharper explosion tells that an unwary man has stepped on a loose stair or has set off some other type of booby trap, exploding a dynamite cap.

Machine guns are keeping up a slow hammering in the streets, kicking up dirt, and there's an occasional whine as a ricochet flies over. Hugging one side of an alley, the men are subjected to ma-



Trainees fire at street targets from the window of a realistic "bar" in training village at Camp Roberts, Calif. Village has about 20 buildings



Attached to loose stair in an "abandoned" house is a booby trap which consists of a dynamite cap. It is activated by unwary soldier stepping on stairs. Below; marching in three "Nazis" wearing captured uniforms





Inching or leaping from building to building in training village, soldiers learn how to take cover from enemy bullets and still advance. Targets consisting of cardboard helmets pop up in unexpected places. Below, man leaps across open space between buildings.

chine gun fire that sweeps down the middle of the road, and another gun at the corner has them bracketed.

From this description of village fighting you might think that it's impossible to avoid a few deaths or injuries. That's exactly the way it seems to the men, too, but the fact is that the whole affair is carefully staged. Instructors are with each group, telling them what to do and when to do it, and the schedules are all timed together.

There are half a dozen different combat courses at Camp Roberts that simulate battle under as many different conditions. Men advance across fields under artillery fire that whiffs past overhead, to learn what it's like to go forward under the protection of their own artillery. Marching down a road, the men may suddenly scatter and then aim their empty guns at a low flying attack plane whose guns have plenty of ammunition. In fact, the pilot is doing his best to scare them. He pours in bursts from his .50 calibers at targets just past the men. The soldiers are getting a taste of ground strafing.

One combat course is along a ravine and is designed to teach a man the technique of fighting back, far better than lectures and demonstrations can do it. One at a time, men are sent along a path on the bottom of the ravine, on reconnaissance.

If they are fired upon they must protect themselves by taking cover, they are told, then hunt for the sniper target and knock it out. A man keeps a pretty careful watch as he advances along the path. He may spot a target in the brush, on the crest of a hill, or in a tree, at any time. But the chances are that he sees nothing before the time a bullet smacks the dirt at his feet and he hears the report of the gun. A sniper has taken a shot at him and he jumps for cover. Another bullet lands close by if he doesn't conceal himself fast enough. The trained marksman who is actually shooting at him is carefully hidden, but there is a target that is visible in the general direction from which the shot came. The soldier must find and hit that target before he can continue to the next without drawing more fire.

Infiltration courses, in which the



Photo by McCormach, Field Artillery, Camp Roberts

Soldiers on infiltration course creep forward as a land mine explodes and real bullets kick up the dust

men crawl along the ground and under barbed wire barricades while machine gun bullets whiz past a foot or so above them, teach them the art of hugging the ground closely. Crawling over such a course, in the dark, is vastly different from a daytime crawl in which you can see your companions close by. After dark each man is on his own. Except for a stealthy rustle here and there in the silences the only sounds are those of the guns. It's pitch black except for the red streaks of tracer bullets that barely seem to miss you, and you pray that there's no rising ground ahead over which you must crawl.

A different kind of course is a "no man's land" of shell holes, fences, and ridges over which the men advance in a run, stopping only to fire at targets that suddenly present themselves ahead. This course is designed to show the soldier how he

must constantly hold himself ready to fire at once on the enemy, in actual battle. The targets are hinged and are raised from the ground by wires pulled by an operator in the background.

It has been said that American soldiers who had never fired a gun were sent into action during the last war. That isn't true now. As part of their basic training all sol-



Trainee battles a cornered "German" in realistic fight



diers learn the uses of their weapons. They fire against still and moving targets and at silhouettes of tanks, throw grenades and operate machine guns.

They even have brushes with Germans and Japs in uniform. Both Nip and Nazi uniforms have been "imported" to this country from captured enemy military warehouses, and these uniforms lend a realistic touch. Soldiers dressed in enemy clothes are captured by their mates who are being taught how to handle prisoners. The questioning of prisoners and the interpretation of letters that are planted in their pockets are other subjects in which the enemy uniforms play a part. All these training aids help give our soldiers the bravery and ability that they are displaying in battle.

Bullet-scarred target of Jap actuated by wire pops up by house as men advance

Pylon Marker for U. S. Airlines Gives "Air Address"

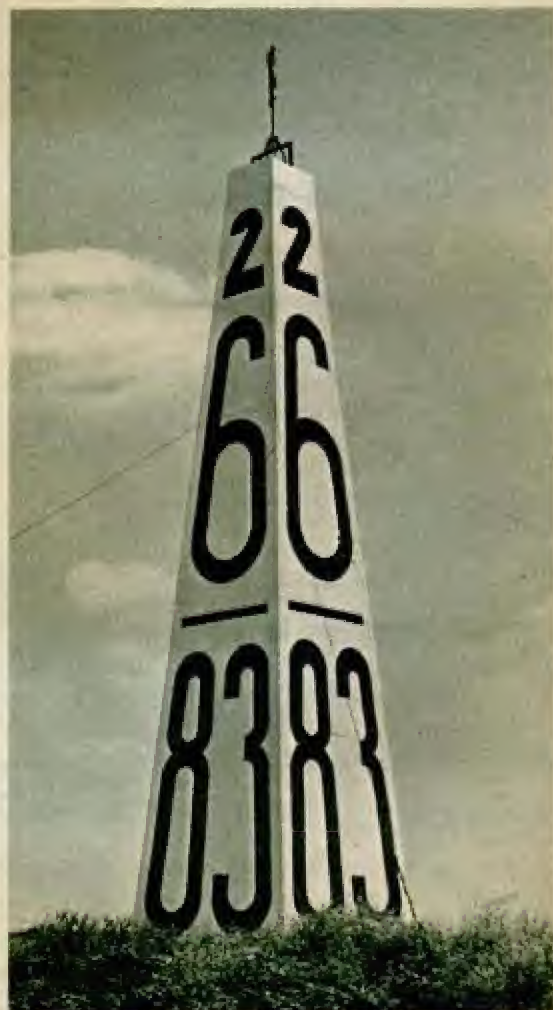
Pilots of "family planes" of the future, unskilled in navigation, may plot their courses with the aid of pylon markers placed about 10 miles apart. Numerals on the markers would indicate latitude and longitude. To make it easy for the pilot, all aeronautical charts would have reference numbers along the margins. The "skyway marker system" was worked out by Prentiss Cleaves, test pilot for Cessna Aircraft Company, who says that anyone could master the system in 15 minutes.

Wichita, Kansas

"Electronic Ear" Tests Shells As They Drop on Anvil

Ordnance plants have adapted the old shopkeeper's trick of tossing coins on a counter to hear whether they "ring true" to test 20 mm. shells. An "electronic ear," called "Sonotest," has been devised to show whether shells are safe to use and load by the way they ring when dropped on an anvil. Properly made shells, without cracks and with their copper rotating bands well seated, will have a certain vibration frequency, or range of tone. Perfect shells will also ring longer than cracked or misbanded ones. The sound is picked up by a microphone, and the resulting electrical oscillations are fed through electric tubes. If the shell is good, a green light flashes; if imperfect, another light warns the operator to discard it. Each shell is tested twice: once by dropping it on its bottom, once by dropping it on its side.

*article in issue of Army
Ordnance, Jan. '44*



Endless Convoys Roll Along Alaska Highway 7772

Over one of the newest and most important highways in the world, a continuous stream of trucks in convoy moves north through dust, snow and rain. The trucks rumbling over the Alaska highway are loaded to capacity with vital supplies for northern outposts. The road is still unpaved and rough in places, but there are stretches where drivers can "hit it up" to 40 miles an hour. The hardy army drivers, who wear weird-looking dust masks in summer and sheepskin-lined clothes in winter, operate in relays. They catch catnaps of about six hours at stations spaced



Herm. Thompson, Jr.



In dry weather, the dust never has chance to settle on the highway so drivers wear dust masks (top). The dispatch board (left) shows position of every truck

100 miles apart. Dispatching of supplies over the highway is well organized, and at the Dawson Creek, B.C., headquarters of the U. S. Army Northwest Service Command, officers know the location of every truck on the 1,600-mile road. After the war, this road will form a vital part of the Pan American Highway System stretching from Fairbanks, Alaska, to Buenos Aires. The highway is now completed from Fairbanks to a point in southern Mexico.



Moisture Magnet and Powder Combat Mildew, Dryness 7855

Two developments to keep the moisture content of air at the desired proportion are a claylike "moisture magnet," which absorbs excessive dampness, and a "humidity storage cell," a powder that absorbs extra moisture in damp periods, and releases this moisture into the air when the air is dry. The moisture magnet prevents mildew in closets and trunks, prevents rust from dampness to tools or sporting goods, and is also adapted to absorb excess dampness in the refrigerator, and, by preventing the accumulation of frost on the coils, delay

defrosting. The absorption turns the material into a semisolid, and it can be baked dry again in the oven, and reused. The "humidity storage cell" is said to give off moisture to dry air, when it has been dampened, and to absorb moisture when the air is wet, thus acting as a constant air conditioning agent.

Write to the firms listed in the Where-to-Buy-It index to learn more about products described in this magazine. Say You Saw It in Popular Mechanics.

*Gaffney Products Co.
261 N. Wells St.
Chicago, Ill.*

MORE POWER



Courtesy Deere & Co.

Sugar beet topper and lifter places the beets in one windrow and tops in another where they can be saved for stock feed. Below, Ford-Ferguson tractor has unit which enables farmer to turn furrow close to the fence



BACK in World War I they used to sing: "How you gonna keep 'em down on the farm after they've seen Paree?"

That song was as prophetic as it was humorous, for the years between the wars were marked by an almost continuous trek of men and women from the rural areas to the cities.

But after this war the experts think they know how to get 'em back on the land—with machinery that will enable the one-family farm to operate at a profit. It's the

less work done by the horse and by the human hand.

"Any young man who has been made mechanically minded by operating the machines of war will not be attracted back to the farm by the thought of plodding along behind eight slow hoofs," says Harry Ferguson, whose firm manufactures the implements used with the Ford tractor, and is responsible for a system of linkage and hydraulic control that makes the lightweight tractor amazingly versatile.

almost endless variety of mechanical hands that makers of farm equipment are developing that will cut costs for the small farmer.

"We are working and planning to do our important share in keeping the small farm operator abreast of advancing farm technology, to help him achieve economic independence—for only by doing that can we keep American agriculture sound at the core."

These words of J. L. McCaffrey of International Harvester Co. summarize the goals of all the farm-machinery makers: Help the small farmer to help himself.

For this program to succeed, there must be

for the FARMER

77 739.



Courtesy Caterpillar Tractor Co.
This beet loader can handle
one ton of beets per minute

A modern tractor replaces 28 horses, saving 277 hours a year that would otherwise be spent on caring for work stock and raising its feed. This is equal to a whole month's work. The tractor gets work done in less time, saves the time spent on caring for animals, and releases for other crops the fields used to grow feed for the animals.

If a half-million modern tractors could be put down on farms that today use animal power, imme-



2 76 at 500 ft.
77 4. 71 7.



Photo from Diesel Progress

Four-row potato digger (above)
powered with a Diesel engine.
Left, tractor pulling a terracer

diately 15,388,888 man-days a year could be saved—equal to the addition of over 60,000 men to the farm labor supply, just at the time when they are most needed.

The matter of priorities makes it highly unlikely that anything like that number of farm machines will be manufactured for



Ditch-digging scoop has hydraulic finger-tip control

the duration; but war's end will certainly bring some eye-openers in the way of mechanical aids.

All the big farm-equipment makers freely admit that they are now experimenting with machines that may revolutionize farming.

"It is true that there will be quite a number of new machines put on the market as soon as the war is over," says a spokesman for Deere & Co. "Naturally, the various manufacturers are not uncovering what they are going to have to offer."

They won't mention everything, but one new machine, the John Deere sugar-beet topper and lifter, is symptomatic of things to come.

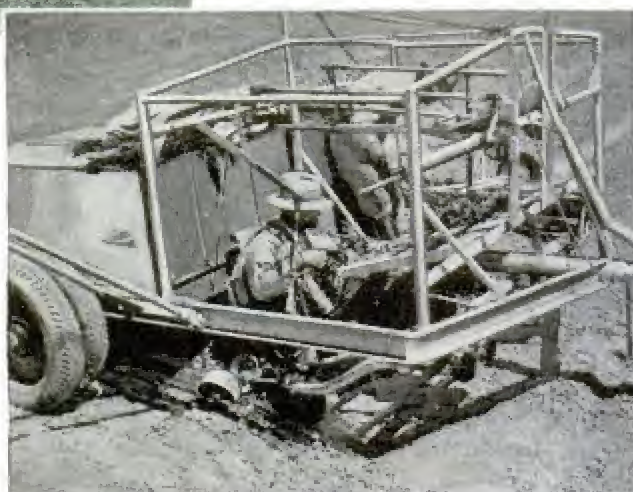
Traditionally, growing and harvesting sugar beets has required vast amounts of hand labor. On one 158-acre tract of the Great Western Sugar Company an experiment is under way in growing beets almost completely without the use of hand labor. The whole acreage was mechanically planted, and it was expected it would be mechanically harvested.

The John Deere sugar beet topper and lifter has been manufactured in limited quantities. Its task is to top the beets, locate the beet in the ground, lift it, shake loose the dirt, then deposit the beets in windrows. Tops are picked up at the front end by fingers mounted on a drum immediately behind the topping knife. They are disposed of in windrows of three or four rows each, where

they can easily be saved for stock feed. The topped beets are lifted at the rear of the tractor and tossed onto an agitating elevator by a pair of kicker wheels. A swinging conveyor places the beets in windrows of six or eight rows each, ready for loading, either by hand or with a mechanical loader.

Caterpillar Tractor Co.'s Diesel tractor and beet loader can load a ton of sugar beets a minute.

Mechanization is making tomatoes as easy to raise as corn, cotton, potatoes, beans, or any other



Courtesy Diesel Progress

Two men can transplant 20,000 tomato plants a day with this machine; it has a 650-gallon water tank which furnishes a pint for every plant as it is set



row crop. One tomato transplanter built and used in the Santa Clara Valley of California is capable of setting out about 20,000 plants a day! Victory gardeners who have spent an entire afternoon setting out several dozen plants can appreciate that figure.

California potato farmers are using a four-row potato digger, made by shifting International Diesel engines from the chassis of their tracktype tractors to the digging device. Yields in this California area range from 300 or 400 up to even 600 bushels an acre.

Several manufacturers are developing new machinery for handling hay. Grass has always been one of the world's basic crops. In the United States, roughly one in every five cultivated acres grows hay—only corn is greater in total acreage and dollar value. Grasses and legumes are vital to soil conservation, erosion control, crop control and crop rotation—but tools for handling hay have changed little in recent years.

Allis-Chalmers has developed a forage harvester, still in the experimental



Portable saw mounted on back of Ford-Ferguson tractor enables farmers to take power to the wood instead of old way of taking wood to the saw



Courtesy International Harvester Co.

Harvesting flax with a one-man, self-propelled combine which will always pick up the heads first regardless of whether crop was cut by right or left-hand travel. Below, Allis-Chalmers forage harvester in operation

Milwaukee, Wis.





Width of soybean rows is no problem with Ferguson cultivator which has wheels that are easily extended

state but capable of handling, under good conditions, from four to six tons an hour. In one field operation it cuts the standing green crop, chops it to the desired length and loads it into a trailed wagon, to be unloaded and delivered into the silo by blower, silo filler or elevator. Or, equipped with a pick-up attachment, it will take hay from windrow or swath, chop and deliver it to wagon or rack, ready for the mow or other storage. Straw can be recovered behind the combine, for feed or bedding.

Other developments include:

A successful mechanical cotton picker, probably not to be placed in quantity production until after the war.

Progress in the development of an economical beet-harvester.

Constant work on tractors, with the goal of making more power available to the farmers.

A self-propelled combine, operating under its own motive power instead of being pulled by tractors, and representing a distinct technological improvement on some types of farms.

Every one of the manufacturers, though, warns that the beating of swords into plowshares isn't go-

ing to happen overnight; there will be a year or two of transition after the war ends, and perhaps even more time to complete field tests on some machines, to make sure they are foolproof. But in the war production program the big manufacturers have learned many things about motors, traction, metals, mechanical aids, that will be directly applicable to peacetime farming.

Typical of the versatility that can be achieved with farm machinery is the "Ferguson System," combined with the Ford tractor, to give the family-farmer an almost endless variety of mechanical hands. Fundamentally, the Ford-Ferguson system is the uniting of tractor and implement

(Continued to page 150)



With this pick-up baler, one man can do the work of many

Lamps Lighted by Radio Beams Need No Wires



Photos from Westinghouse Electric & Mfg. Co. Lamps which are lighted by wireless electronic power, heating with infrared rays, and the use of light for cooking are some of the current developments that may find wide usage in the homes of tomorrow. Also new is the shatterproof bulb (above) designed for use in shipyards where welding sparks are hazards. It has a special lacquer coating and sturdy filament. Above, right, twin infrared lamps rigged up beneath desk serve as foot warmers. These lamps dry paint on tanks in few minutes

40 Wall St.
N.Y., N.Y.

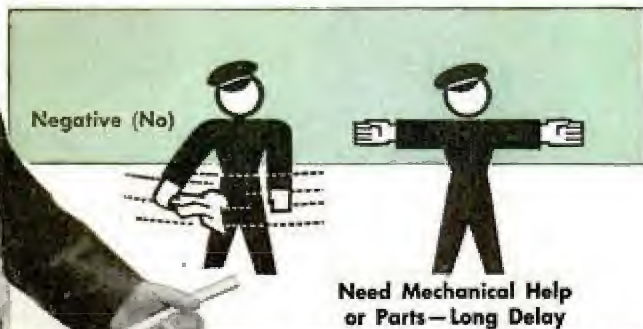


Cooking bacon and eggs on the upturned lens of head-lamp from army bomber shows how wartime lamps may be converted to peacetime use. This sealed-beam type of lamp cooked the bacon and eggs in four minutes. Lighting engineers predict that similar lamps for heating will be mounted in ceilings or recessed in the walls alongside ultraviolet lamps. Left, the glowing fluorescent tubes have no wires and get their radiated power from electron generating tubes. Used for lighting airplane instrument dials, or clocks, they require less current than an electric clock. Despite spectacular strides in transmission of electric power without wires, engineers believe that in most instances the practical use is many years away

*Mr. Allen Warren & Matt, 7 Park Ave.
N. Y. 16 N. Y.*

THEY BRING THEMSELVES

From Main Street to a snug raft in midocean or a tropic jungle is quite a social revolution but the Yankees are mastering it with ingenuity. The fishing kit at left is standard on Navy lifeboats; sign talk with arm motions has also become standard



Use Drop Message

Can Proceed Shortly Wait If Practicable



A NOVEL development of this war is the way ingenious lads from Main Street, U. S. A. are managing to bring themselves back alive when marooned in the steaming jungles, on the oceans and in densely thick-eted islands of the South Seas.

Cheating death in the tropics is being reduced to a science. Every branch of the armed forces is building up courses of instruction teaching how to forage for food and drink, how to sleep, travel, signal for help and hide from enemies, both human and animal. But much information on which the instructors are basing training courses, devising special equipment and improving materials to withstand the ravages of tropical climate came from the experiences of quick-witted young pioneers who fought to safety on their own.

Most of the men who found themselves stranded in the green hells of the tropics have been fliers and airplane passengers, and in the early days of the war, the spec-

tacular instances involved crash landings at sea followed by days of drifting and torture by hunger and thirst. Out of these harrowing episodes came improved life-rafts, emergency fishing equipment, methods of purifying salt water, trick sails, aluminum paddles, waterproof signal lights, better emergency rations, two-way radios and now even red sunshades to attract rescuers and protect drifters.

Many shipwrecked men succeeded in landing on a desert island only to starve, or be poisoned by eating deadly tropical fish or fall victims to hostile natives or Japanese. Others came through alive, and from what these survivors learned about

77 728

BACK ALIVE

Five-foot parachutes of paper (right) used to drop food, weapons, ammunition and medical supplies to troops cost only \$2.50 compared to the \$75 or \$100 nylon or silk chute. Below, a British patrol keeps rifles dry while wading a jungle river in Burma



life in the jungle a basis was formed for army, navy and marine textbooks. During the campaigns in Burma, thousands of troops isolated hundreds of miles from help—lacking food, water fit to drink, ammunition and medical supplies—were nursed to safety by fleets of airplanes which dropped necessities by parachute. So parachuting supplies into the jungle has become a science too, the latest innovation of which is the Dennison five-foot paper parachute which will carry a 50-pound load to earth although



Pan American Clippers carry gasoline-operated stills for producing fresh water from the ocean



Pan American crew members spot safety equipment on diagram of Clipper. Papuan natives build litter to carry blood plasma to Yanks in jungle
American Red Cross photo



it weighs only 21 ounces and costs only \$2.50 as compared to a \$75 to \$100 silk or nylon chute.

Few have extricated themselves from the jungle with better effect than Lieut Wallace L. Dinn after he had bombed a Jap base, lost his plane, and floated down on the same island ten miles away. He landed in the midst of a savage tribe which had just finished eating two Jap aviators and they seemed to be interested in his muscular physique and a change of diet.

Like a Yankee Clipper ship trader, he quickly managed to master pidgin English—hiring big fella canoe by promises of many big fella knives; induced natives to take him to an island where a Jap flier was marooned, captured him for questioning and sailed into an American naval base in a war canoe, like an island potentate.

Ingenuity saved four aviators whose plane conked out over a South American jungle. The pilot picked out a flat spot and made a belly land-

ing, only to slither to a stop in quaking mud five feet deep, with a consistency approaching that of quicksand. While waiting for an injured comrade to improve, they lived on top of the plane, collected rain water in parachutes, fashioned "snowshoes" which would support them on the mud, then slogged along 20 days until they reached a stream, built a raft and floated to civilization.

Lieut. Tommy Harmon, former University of Michigan football star, survived seven days in the jungle after finding himself hanging by his parachute lines from a tree, his companions dead. Tortured by insects and slashed by sharp tropical leaves, he lived through three attacks by crocodiles, kicking them out of his path, set a course by his pocket compass, followed it across swamps 15 feet deep, learned to avoid impure, slimy waters by following streams to their point of origin where water was fresh, mastered the art of constructing a nightly lean-to of branches, leaves and mosquito netting and had the presence of mind to recognize a slash on a tree as a mark of a trail leading toward



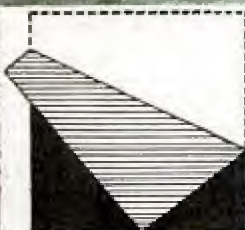


American Red Cross photo

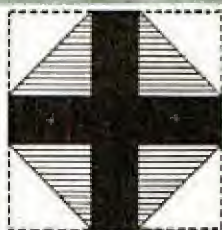
Friendly New Guinea natives carry an American out of the jungle to safety



**Need Gasoline and Oil
Plane is Flyable**



**Need Tools
Plane is Flyable**



**Need Medical
Attention**



**O K to Land—Arrow
Shows Landing Direction**



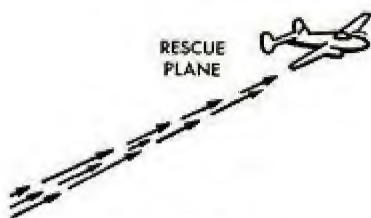
**Do Not Attempt
Landing**



**Indicate Direction of
Nearest Civilization**

"Code" messages above, for signaling with blue and yellow panels to plane, are from U. S. Army Air Force handbook, "Jungle and Desert Emergencies." How to attract plane with mirror is shown below, at the left

RESCUE
PLANE



TOP OF MIRROR
MUST BE LINED
UP WITH TOP OF
AIMING STICK AND
RESCUE PLANE

How an aiming stake can be used
to aim a mirror for signaling



human habitations. Prayers, he found, gave him more courage, patience and sustenance than air force rations, helping him to struggle along when he wanted to give up and perish.

Captain Legrand Kneeskern came through in New Guinea three weeks after a landing so rough he broke the knife in his jungle kit. He dusted sulfanilamide powder over his wounds, put on gloves and head net and rested until he was able to walk. Having lost one of his jungle boots, he put both socks

on his shoeless foot and started for "home." The socks soon wore out, so he cut a sole from the top of his remaining boot with a razor blade. When this was gone he made another shoe from his life preserver. This was cut to pieces also and he improvised another shoe from the sleeve of his flying jacket. Wearing this, he plodded through the jungle, eating bananas and other wild fruit until natives picked him up.

The crew of a battered B-17 bomber operating out of Guadalcanal pancaked to the sea 500 miles from land and dragged themselves on rafts. Dressing each other's wounds, they made a rain catcher out of a canvas flare container cover, fashioned a sail out of parachutes, used a nail file to form a fish hook from an emergency ration can opener, kept themselves alive until they landed on a native island. Here they taught natives to sing in return for food and obtained the use of a canoe by promising knives and axes. They sailed back to safety.

Thousands of experiences have been translated into



Concealed by camouflage resembling a tree stump, one Marine keeps watch while partner reports to command post by field telephone. Below, seven-man raft for Flying Fortresses, made by U. S. Rubber Co., has a sail and tarpaulin for sun protection



jungle, desert and sea tactics which have been written into textbooks. One of these, "Jungle and Desert Emergencies," issued by the U. S. Air Forces, a pocket-size volume printed on water-resistant paper and impregnated with an insect-repellent chemical, sums up the latest in modern pioneer lore.

"Don't fear the jungle," it advises, pointing out that a man can live weeks in the wilds if he avoids panic and uses his head. Good food and water are fairly plentiful in the jungle if you know where to look, it says. Most wild animals won't bother you unless you bother them. There is little more chance of being bitten by a poisonous snake than there is of being struck by lightning back home. With the exception of those of New Guinea and Assam, jungle natives will be friendly if you make friendly approaches to them. Don't try to bully them. Malaria is your worst enemy. If you have your first-aid kit, start immediately to take preventive doses of quinine or atabrine.

Aviators have learned to signal for help by placing bright-colored or reflecting objects where they will mirror the sun back into the sky. Gasoline fires are being used. Engine oil thrown on a fire will produce black smoke. Water will send up clouds of steam. Yellow and blue panels can be folded to give messages to planes overhead. A code of arm and body signals conveys messages to rescuers. Marooned men are trained in the use of mirror signals as follows:

"When the sun is shining, a mirror or any piece of shiny metal—your rear-vision mirror, a food tin, or a piece of metal from the plane—can be used as one of the best of all signaling devices. However, the mirror must be accurately aimed if the reflection of the sun in the mirror is to be seen by the pilot of a passing plane. One of the simplest ways to aim a mirror is to use an aiming stake. Any piece of wood four or five feet long can serve as the stake, or one of your party can stand in position.

"Hold the mirror so you can sight along its upper edge. Change your position until the

top end of the stick and the plane line up, then adjust the angle of the mirror until the beam of light reflected by the mirror hits the top of the stick. If stick and plane are then kept in the sighting line, the reflection will be visible from the plane.

"Some emergency kits are now fitted with a special signaling mirror, which is a double-faced mirror and provided with a sighting or aiming hole.

"Hold the mirror about three inches away from your face and sight at the plane through the sighting hole. The light from the sun shining through the hole will form a light spot on your face and this spot will be reflected in the rear surface of the mirror. Then, still sighting on the plane through the hole, adjust the angle of the mirror until the reflection of the light spot on your face in the rear mirror just coincides with the hole. In other words, when the reflected spot disappears and the plane is still visible through the hole you can be sure that the reflected light from the sun is accurately aimed at the plane."

Water is important. Following a brook downstream will often lead to civilization. Digging a four foot hole will usually produce drinking water. Animal trails lead to water. The stems of many vines ooze water when cut. Rain water can be collected from depressions in large leaves.

A parachute makes a good tent, knapsack, rain collector, or a trap which may be placed across a stream holding fish where they can be speared with a lance whittled from bamboo.

Men are taught not to fight the jungle by pushing through it. The correct thing is to part the underbrush, crawl under it or go around.

Most tropical aviators know how to operate a simple firemaker by twirling a stick into a collection of dry tinder placed around a hole in a piece of wood. They can improvise bird and animal traps.

Some general diet rules are these: eat nothing that has a bitter taste unless you are sure what it is. Avoid all plants that have a milky sap. Anything that you see monkeys eat, you can eat. All shellfish are non-poisonous. Balloon fish are deadly. If in doubt about the wholesomeness of food, try a very small particle. Most snakes are edible except sea snakes. All birds and animals are good fare, along with grubs and grasshoppers, but caterpillars are to be avoided. Don't eat the legs and wings of insects.

A score of men from the Army, Navy and Pacific Rangers spent three weeks marooned on a tropic isle off Hawaii to prove that a smart man with a machete, bolo, trench, or cane knife could find a good liv-

(Continued to page 152)



In checking close tolerances, the element of human error is said to be eliminated with an electric limit type comparator, which shows by colored lights whether the work is within the tolerance limits. Readings to an accuracy of one ten-millionth of an inch may be made quickly by an untrained worker. A red light shows under-size, a green light oversize, and an amber light shows measurements within tolerance. The traffic-light type of reading may be supplemented, for a color-blind inspector, by bells or buzzers as signals.

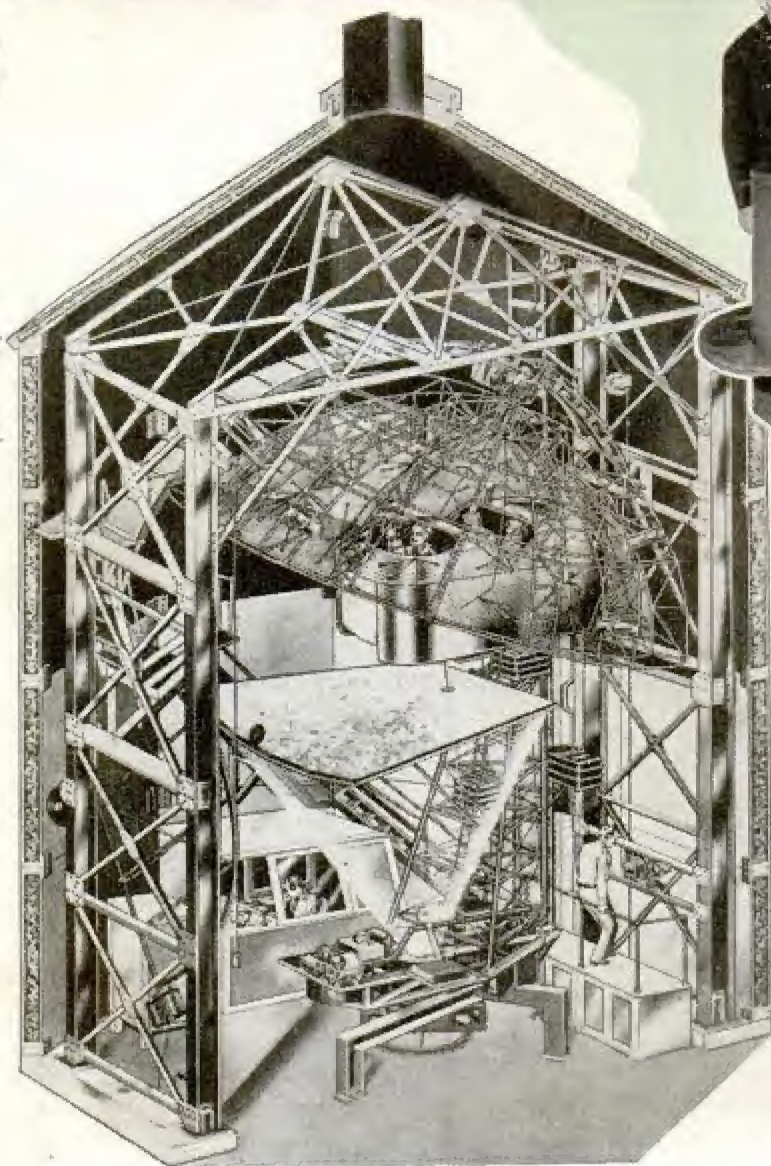
Tire Made From Elastic Plastic **Is Resistant to Sun's Rays**

In the race to produce the best postwar tire, natural and synthetic rubber may be given some stiff competition by the new elastic plastic, called Plioflex. One tire made of the plastic has run 8,000 miles. Plioflex, developed by the Goodyear Research Laboratory, in Akron, Ohio, is said to be the first elastic plastic capable of being vulcanized during molding operations, and can be handled in hot molds just like natural rubber. The finished product is not affected by the sun's rays. Postwar uses predicted for it in addition to tires, include a lightweight garden hose, heels and soles for shoes, various automobile parts molded from rubber, and coating for fabrics and papers. One possibility is a Plioflex shoe with a finish resembling leather. The plastic can be colored any shade of the rainbow.



TRAINING FLYERS

U. S. pilots and bomber crews master their first problems of flight and combat with the aid of intricate training devices — on the ground. Left, student navigator "shoots the stars" from dummy fuselage. Stars are projected on celestial dome overhead. Behind him are the instructor, the pilot and radio operator



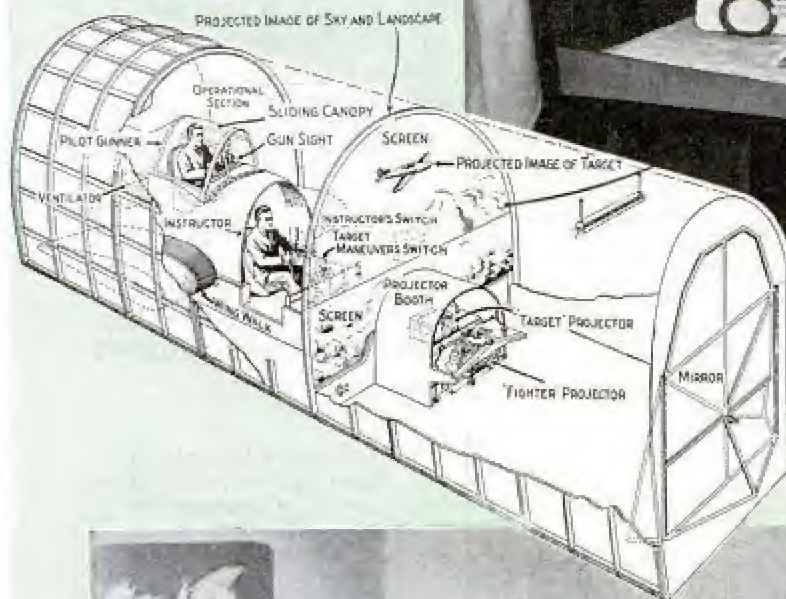
Student gunner (above) looks into viewing box of "panoramic" trainer learning how to "lead" target. Left, cutaway of celestial navigation trainer showing instructor sitting in booth at base of unit. Passing terrain is projected on screen beneath student "crew," stars on dome above. Below, teaching range estimation with mirrors simulating a range of 2,800 feet



*Col. Dwight H. Eddy, Air Corps, Chief,
Training Air Div., 1 Park Ave., N. Y. 17*

on the GROUND

Instructor (right) is giving a student navigator "preflight" information for a dead reckoning mission in the Navitrainer. Navigation instruments are like those student will use later on to guide bomber to enemy target



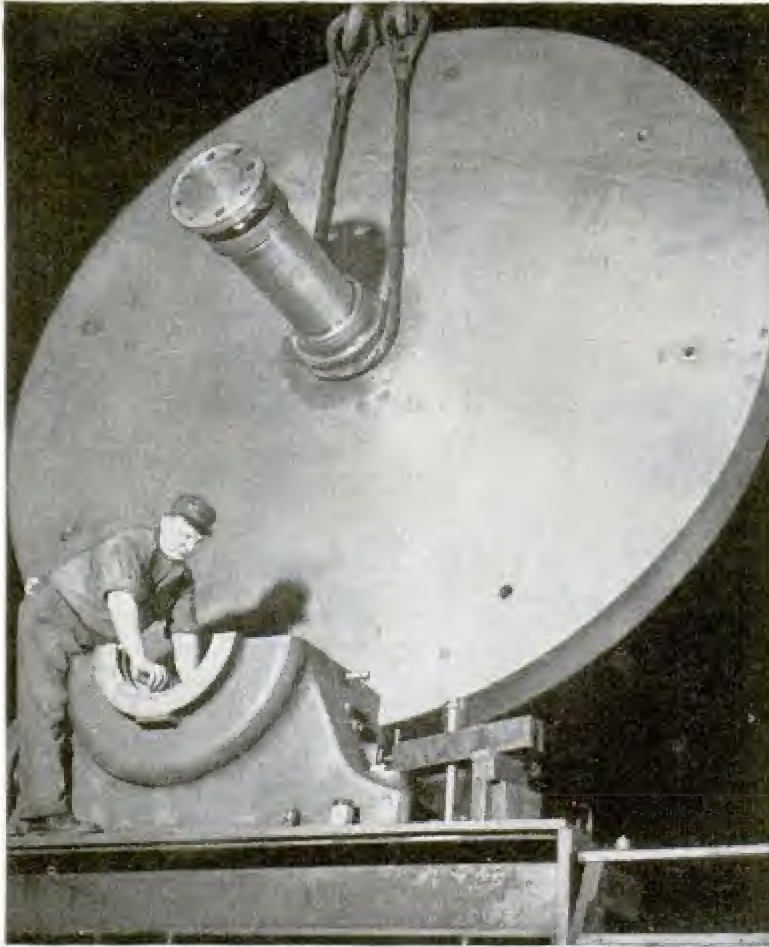
Cutaway view (left) of the "gunair-structor" which gives illusion of flight with horizon projected on a screen and moved through controls. It teaches correct aim for every position of target. Below, fixed gunnery deflection trainer has target which is set for any air speed



"Ditching dummy" (below) teaches land plane crew how to cheat death at sea after crash



"Spinning Top" Stores Power for Rolling Steel



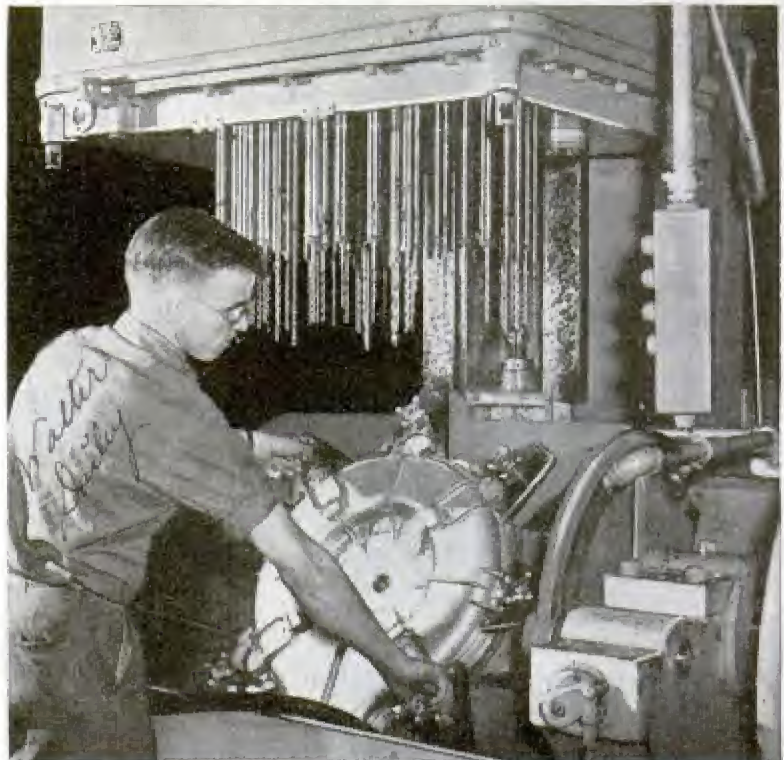
Enough energy will be stored by one giant flywheel that is part of an electric motor-generator set to raise a battleship a foot in the air. This storehouse of power will take care of peak loads in rolling slabs of steel at the Kaiser plant at Fontana, Calif. The flywheel, built at the East Pittsburgh Works of the Westinghouse Electric & Manufacturing Company, is 14 feet high and weighs 38 tons. At top speed, the outer edge is traveling 250 miles an hour. The huge wheel is balanced so that it vibrates less than the width of a human hair.

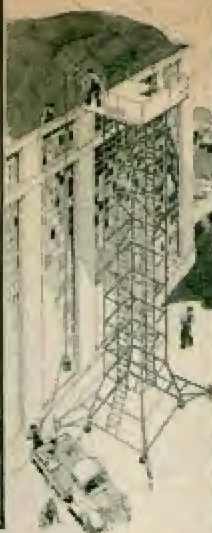
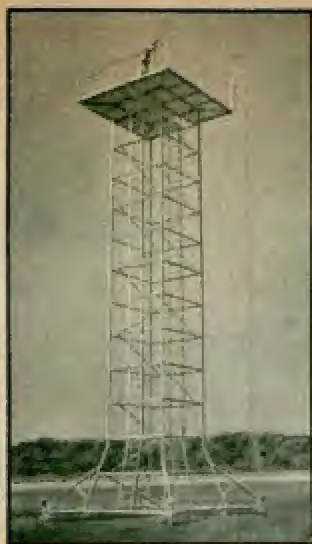
The outer edge of this 38-ton flywheel, which is part of an electric-motor generator set, moves 250 miles an hour at top speed. It serves as power storehouse for peak loads in rolling steel

52 Holes at Once Are Drilled in Aircraft Part

To speed the manufacture of airplane parts, one machine at the General Electric Company's Fort Wayne, Ind., plant drills 52 holes in a single operation. It is used to make casings for superchargers. The machine is adjusted for precision work measured by thousandths of an inch.

Resembling stalactites, drills in this time-saving machine are poised over supercharger casing. A single operation makes a maximum of 52 holes





71 908
 Comm. 220 & 240
 Office of Public Relations
 Navy Dept. Washington, D.C.

Jiffy-Built Tower, Motor Crane, Aid Aviation Mechanics

To aid mechanics in the repair of airplanes and their hangars a "high stand" and a crane for removing aircraft motors were demonstrated at the Marine Corps Air Station at Quantico, Va. The stand may

be erected to varying heights. At its highest point it is suitable for maintenance of hangars, and for use as a platform for machine guns. The crane is 25 feet high, and its capacity is 6,000 pounds.

12-Inch Telephone Lines Connect Riveting Teams

Riveters and rivet-buckers, as well as other teams of workers in the Boeing Aircraft plants, communicate by telephone. In some cases telephones are required when the workmen are only a foot apart. When working on opposite sides of a large plane part the workers cannot see each other and the noise of the factory makes ordinary voice communication virtually impossible. Some of the telephone lines extend as far as 50 feet so that workmen can talk to each other while working on remote parts of a ship. In the Wichita plant, the Boeing company has more than 200 such telephone sets.



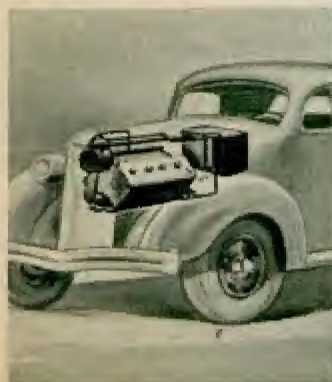
Wichita Div., Wichita, Kansas

Cold Engines Started Quickly by Diluting Oil After It Leaves Motor

Developed for aircraft engines that must be started at a moment's notice despite zero cold, a new cold-weather lubrication

system is also adaptable to automobiles, trucks and tractors. It consists of diluting lubricating oil with gasoline after it leaves

the motor on a return trip to the warm-up compartment. Previously, the gasoline was added before the oil entered the motor where it was partially evaporated by the hot motor. Pilots had enough thin oil to start with, but the rest of the system was clogged with thick oil and there was danger of bursting the air cooler. The improved method was developed by a Glenn L. Martin Company engineer.



Baltimore, 3, Maryland

OUR NEXT WORLD WAR-



NEXT to the impact of Jap steel, our fighters in the Far East fear most the sting of a mosquito. Next to the roar of a Jap bomber, they dread the hum of the tropical pest which carries a deadly cargo of malaria and yellow fever germs.

In the European war theater the familiar "cooties" of the last World War are keeping troops busy scratching when not fighting Axis foes. Typhus is the main weapon of these lice.

In the United States, the shortage of farm manpower has left millions of acres untilled and subject to the fresh encroachments of hungry insect hordes. The shortage of insecticides has added to this problem.

Spider photo from "The World Is My Garden," by David Fairchild, published by Charles Scribner's Sons. Top, spraying trees with insecticide to control destructive infestation (photo from DuPont). The tough-looking hombre above is a turret-making spider. Below, mosquito bar covers a soldier's hammock hung between trees in a tropical jungle.

Mr. J. M. Elliott
7 Park Avenue
NY 24, 16, NY 24



Stimulation of travel has multiplied all of these menaces because both insects and the germs they carry are restless hitchhikers, seeking new fields for their ceaseless campaign against mankind by plane, train, bus, truck, automobile, ship and even by the person of man himself. The comparative shrinkage in the size of the world has made the insect menace a really alarming one for the first time in history.

POPULAR MECHANICS

77806

AGAINST INSECTS

Uncle Sam, fighting one World War, is preparing for the next—and this one will be a long and bitter battle to crush the creeping, wriggling, flying, burrowing billions whose numbers and depredations baffle human comprehension.

Not that we are doing nothing about the present menace to our troops and civilians. The sharpest scientific brains of the nation are already enlisted in the war on insects. But at best, present efforts can be only a holding action as compared with the coming fight on man's insect enemies. Under the leadership of Surgeon General Thomas Parran of the United States Public Health Service a movement has started for a joining of world-wide forces of friend and foe alike, when peace comes, to eliminate the insect threat to man's welfare.

The size of the army we face may be judged by the following recently revealed facts and estimates:

Calculating the world's population at above 2,000,000,000 human beings, there are probably that many insects on or in the soil of an average square mile of land. In addition, there are as many as 5,000,000 insects in the air above each square mile. The total weight of the world's insects is probably greater than the weight of all other land animals combined, big as they are by comparison.

How prolific insects are is shown



U. S. Public Health Service photo

Anopheles quadrimaculatus making a bayonet charge. This is the malaria-bearing mosquito, its beak boring into skin



U. S. Department of Agriculture photo

Mosquitoes shun arms treated with a repellent (above, at left) to alight on untreated arm of entomologist. Below, airplane sprays poison on breeding place of mosquitoes





Spraying plants in the DuPont pest control laboratory. The apparatus duplicates effect of pressure sprays used on mobile rigs in the field

While it takes exactly seventeen years for one variety of locust, or cicada, to reach the adult stage and some worms six to eight years to grow up and turn into beetles, the mosquito can become a full-grown nuisance in about ten days, ready to spread disease. This is one reason the mosquito is man's greatest insect enemy.

The queen of a colony of termites, which resemble winged ants and which attack any form of wood including the front porch, spends all of her time laying eggs and to do so sometimes swells to the incredible length of eight inches.

Caterpillars eat an estimated \$25,000,000 worth of our food a year. Our farm-

ers raise 2,000,000 acres of corn each year merely to feed the corn ear worm. Each female lays about 1,000 eggs and they go through two or three generations a season. From five to 10 percent of our apples are ruined by the codling moth. The annual insect damage to our trees is estimated above \$150,000,000 a year. Clothing moths alone cost us around \$20,000,000. Insects which feed on our stored grains and flour run up a food bill of \$300,000,000.

by the fact that a pair of flies starting in April might have by August 191,010,000,000,000,000,000 descendants, if they all lived, or nearly five trillion tons, at a rate of 20,000 flies to the pound. Each fly is capable of giving a human being typhoid, diarrhea, amoebic dysentery, tuberculosis, anthrax, leprosy, tapeworm, hookworm, whipworm, bubonic plague, yaws, ophthalmia, trachoma, erysipelas, septicemia and gangrene.

The animal group made up of insects includes around 640,000 species. There are more than a quarter of a million types of beetles, 120,000 kinds of butterflies and moths as against less than 1,000 varieties of fleas. We notice fleas more because they attack man and his domestic animals.

Most of these figures were compiled by Anthony Standen, leading entomologist and author of the book "Insect Invaders," who, summing up a world-wide experience in killing the creatures, remarks: "I hate insects. I admit that they are completely and utterly fascinating, but for me it is the

A Marine Corps sergeant murders mosquito larvae by laying a coat of oil on the surface of a swamp near an American camp on Guadalcanal, helping to control malaria in that region

U. S. Marine Corps photo



fascination of horror." He fixes the total cost of insects to this nation at \$1,000,000,000 a year aside from the toll of disease they spread.

The farmer has long been aware of the voracious Japanese beetle and his thousands of annoying cousins, the orchardist dreams of fruit moths on his bad nights, the housewife shudders at the discovery of a domesticated insect and many victory gardeners grew downright discouraged when they saw what insects could do to their little plots. But it was the American defeat at Bataan which aroused the nation's military leaders to the danger which insects held for our war effort. We were not beaten by the Japs. We were licked by malarial mosquitoes and the lack of quinine.

Nor was it the Japs who delayed



Fumigating a Pan American Clipper to kill insects on arrival from tropic port

Grasshoppers (left) have proved one of the greatest pests in our grain regions

American Home Products Corp. insecticide laboratory raises millions of flies



Photo from "The World Is My Garden," by David Fairchild, published by Charles Scribner's Sons

the capture of Guadalcanal. Again it was the mosquitoes in the festering jungles which sent marines to their hospital cots weak and shivering from malaria. As jungle fighting increased, the malaria rate jumped from 30 per thousand men in 1942 to 80 per thousand in 1943.

Strangely, the first two years of war have revealed that the best weapon against the most numerous insects encountered by servicemen is the old familiar standby—mosquito netting. You may get proof of this the next time you attempt to buy curtains, since the greater part of the curtain industry is turning out netting for the millions of





It's breakfast time for lice in the Department of Agriculture. An entomologist lifts patches bearing lice gorged on human blood

troops who will be overseas. A single army order called for 27,769,000 square yards of olive drab netting.

Probably the second most effective weapon resulted from the Department of Agriculture research which converts pyrethrum—a high ranking insecticidal material—into a more potent form than ever before, an aerosol or fine mist that is a cross between a fumigating gas and an ordinary fly spray.

At a twist of the thumb, the insecticidal aerosol comes out from a special container—a so-called "bomb"—as a fog that remains suspended in the air longer than any spray and penetrates into hidden places where insects may find protection against the droplets of a liquid spray. The knockout fog from one such release will kill the insects in a room 10 feet square and 10 feet high. One bomb holds the makings of enough aerosol to keep 10 such rooms free from mosquitoes for 50 days.

This "bomb" method, not now available for civilian use, will be one of the principal weapons for the post-war drive on insects. Another development promised to civilians by Du Pont will be nylon window screens, not only rustproof but almost transparent.

Promising, too, are experiments conducted in fumigating airplanes with an insecticide carried into small cracks on particles of smoke.

In an effort to test new insect poisons to relieve the wartime shortage, the Department of Agriculture raises large colonies of cooties, feeding them their favorite food, human blood, from the

persons of volunteers. Along a similar line, chemists of the American Home Products Corporation in New Jersey feed flies a special, balanced diet of enriched bread, irradiated yeast, malt, bran and milk. It's like giving a doomed criminal a sumptuous meal before execution, for, as soon as the flies get fat and healthy they are put in a death chamber and sprayed with a given amount of insecticide. The number of dead flies determines the rating of the preparation being tested.

Literally thousands of poisonous substances are being investigated as well as hundreds of traps, lures and methods. Meanwhile, drainage of marshes, oiling of ponds and ditches, dusting and spraying of crops continue pending the day that the real war on insects can be declared.

In the interim, the march of the invading insects goes on, covering the earth from pole to pole with the exception of the oceans which they have never been able to penetrate.

Even in steel, concrete and brick cities like New York they manage to flourish and scientists examining the roofs of skyscrapers as tall as those in Rockefeller Center have been puzzled to find the same caterpillars, beetles, flies and moths you would expect to see in a cornfield. In fact, a shopkeeper in this section opened his doors one morning to find scores of specimens of the praying mantis crawling over counters and shelves.

Spray "bomb" shoots mosquito-killing mist into a soldier's pup tent in a swampy region infested with malaria



Nazi "Plow" Plants TNT in Torn Railway Bed

Retreating German troops in Italy wreck railroad tracks with a 10-ton machine that literally plows up the ties. The machine (right) is dragged along the tracks, chutes on the sides dropping explosives on the rails. British commandos captured this "plow" in Termoli railroad yards



Left, inspecting two-pound charge dropped by track wrecker during demonstration in Italy. The explosives are dropped down chutes and held to the rails by clips. They are set to explode in a few seconds



Along "road to Rome," Fifth Army found Nazi demolition crews had blown small gap in rails about every 20 paces. Left, British soldier looks over section of a main railroad line after Germans had torn it up with the wrecker that snaps ties like matches

7735

NEW MAGIC in BLACK GOLD



compile at the end of the test which you could translate into aircraft speed, range, and load.

Better fuels and lubricants for efficient aircraft engines are only two of the thousand and one subjects being studied at the "University of Petroleum," Shell Development Company's research laboratories at Emeryville, Calif. On its seven-acre "campus" a staff of 800 scientists and research people are busy taking apart the hydrocarbons that make up crude oil, then putting them back together in new combinations.

They can turn crude oil into a gas, a liquid, or a solid. They can take highway paving material and gas for barrage balloons out of the same barrel of crude. Better yet, from that barrel they can extract material for making false teeth, explosives, synthetic vitamins, rubber,

Left, measuring depth of oil well with Lane-Wells measuring sheave, accurate within fraction inch. Below, checking amount of lead in high-octane gasoline

THE young technician grinned as he chalked up a new flight on the bulletin board:

"Round trip, Honolulu to Tokyo. Bomb load, 10 tons.

That flight existed only in his imagination, of course, yet it added a touch of adventure to the prosaic engine test he was making. He knew that if such a flight becomes practical it might owe a lot to just the kind of routine test he was running today.

He returned to his control panels, flipped a couple of switches, and settled down to watching a dozen dials and gages as the test equipment behind the glass window took up its steady roar. Today's experiment concerned a new design of aircraft cylinder, fed with a super-high-octane fuel and lubricated with a special oil. He'd have some interesting figures to





Petroleum gets around in myriad disguises: table ornaments, necklace, clarinet and furniture of petroleum plastics, light-conducting styrene rod and synthetic rubber tires are only a few of its ultimate forms

gasoline, flavoring extracts, and garden fertilizers.

Military secrecy surrounds much of today's research. Not until "V Plus Two" can some of the new discoveries be put to ordinary uses. "V Plus Two" is the handy formula that represents, roughly, the years after victory when much that is new in science will be available to you and the chap next door.

But it is no secret that the petroleum industry is talking about 50-mile-per-gallon

gasoline and 100,000-mile tires. Such gasoline, in fact, is the high-octane stuff that is going into the fuel tanks of military aircraft. It wouldn't do much in your present engine, built for medium-compression pressures. More efficient engines must be built to take advantage of high octane fuel—smaller, lighter, and of higher compression than the engines we use today.

Still, the industry doesn't guarantee to put 50-mile gasoline in every pump. With conservation of our petroleum resources of



North American Aviation employees exhibit helmets and visors of petroleum plastics. Below, electron diffraction camera analyzes samples of crude oil



more importance than ever, the fuel of the future may well be that particular grade that delivers the greatest number of miles from every gallon of crude oil. There are lots of complications and it's too soon to say, now, what the octane number of that optimum fuel will be.

Shell's scientists study petroleum under infrared radiations and probe it with ultra-violet light. They whirl it in a super-centrifuge powerful enough to centrifuge the copper out of brass. They subject it to X-rays and weigh it on balances that show a difference of $\frac{1}{450}$ -millionth of a pound. They distill it in vessels that contain only one-millionth the pressure of the atmosphere, and they photograph its makeup in electron diffraction cameras that reveal molecular chains.

This latest research tells them some of the things they can do with the hydrogen and carbon molecules in crude oil, then they set out to manufacture a tiny bit of the substance their research discovered. First they do it on the laboratory table,

then they move to a pilot plant that resembles part of a miniature refinery. In this plant they apply the heats, pressures, and catalysts needed to produce the new chemical compound, and work out any production bugs that develop.

Research like this produced cresylic acid from petroleum at a price that permits it to be used in refining low-grade copper ore. Such investigations produced a chemical method of superfinish for smoothing the wearing surfaces of engines. The scientists found chemicals which under certain conditions reduce the melting point of metals right at the surface. Added to lubricating oil, it permits the heat of friction to



Test machines rub steel balls together to measure metallic wear under various pressures and lubricants

finally, with butadiene, another petroleum derivative, into rubber. It is being produced in vast quantities for this last use today.

Shell is concerned not only with new and better products but with better ways to explore for oil, more efficient methods of recovering it from the earth, and improved ways of breaking it up into the products.

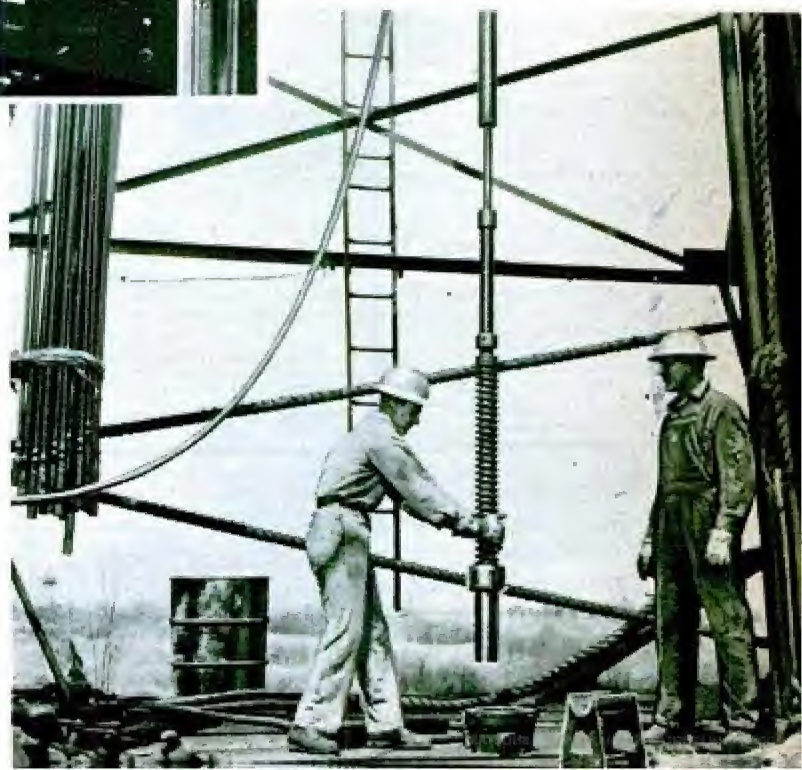
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Technicians above watch behavior of engine burning special fuel in test cell. Below, "plugging back" a well with bridging plug to explore intermediate strata for oil

smooth out all the microscopic high points on cylinder walls and bearings.

Such research produced styrene from petroleum, a chemical jack-of-all-trades that starts out as a pungent water-clear liquid and can be turned into a transparent solid for use as window panes; into insulators for high voltage electricity; into a cellular honeycomb that weighs one-twentieth as much as cork; into a cottony fiber that insulates against heat, and



Navy Tug Has a Train Ride to Launching Site



Tough little tugs built for the Allied war fleets at Trenton, Ont., see a good deal of Canada before they go off to war. Their 13½-ton Diesel engines are built in Vancouver, their plates come from Montreal, and other prefabricated parts from around the Dominion. The welding and assembly

are completed in a plant two miles from water, so the tugs are loaded on flatcars for a two-mile train ride to the launching site. After trial runs on Lake Ontario, including tests of fire fighting apparatus, they are shipped aboard big ocean transports from American ports to their theaters of duty.

'Supercharged' Airplane Heater Weighs Only Six Pounds

Stratosphere comfort is assured with a midget heater designed for use in bombers, fighters, or any high altitude craft. The

gasoline-burning heater, which weighs only six pounds, lights and burns almost instantly at temperatures down to 70 de-

grees below zero and altitudes ranging from 57,000 feet (simulated altitude in pressure chamber test) to sea level. To support combustion in the upper altitudes, a surplus of air is mixed with the fuel as in the cylinder of a supercharged engine. Vaporized fuel is burned in the center of a column of spinning air produced in the combustion tube by an electric-motor-driven fan. Large planes use as many as 15 of the midget heaters, not only to warm compartments but to prevent ice from forming on wings, to keep bomb sights clear, to keep instruments, gun breeches and other equipment operative, and for warming the engines. The unit was developed by Surface Combustion Laboratories, Columbus, Ohio, and Wright Field engineers.



*Mr. C. D. C. Powers
2108 Terminal Tower
Cleveland, Ohio.*

FLAK, UNLIMITED

*Mr. Thompson
3872 Franklin Ave.
Los Angeles 27, Cal.*

ONE of the mechanical marvels of the war is the Bofors 40 millimeter antiaircraft gun. An electric brain tells it where to aim. Electric muscles point its barrel at the target. Its shells are fired automatically. The human gun crew simply keeps it supplied with ammunition.

This automatic cannon uses high explosive tracer shells that can be fired at up to 120 rounds per minute, and fused to burst upon contact with any part of an airplane's structure. One shell can blast apart an aircraft engine or rip off a wing section.

What good is it against enemy aircraft that stay out of range? It keeps them high and makes bombing inaccurate. The automatic's big brother, the 90 millimeter high altitude gun, works on aircraft that stay in the upper levels.

But the Nips and Nazis are doing relatively little bombing from high altitudes. Much of their operations against Allied installations are at low altitudes, within the range of .50 caliber machine guns and the 40s.

A 40 millimeter cannon has its own power supply and its own mechanical director. The director is a mathematical computing machine that is mounted on a turntable so that its operators can watch and track the target aircraft through telescopes that are attached to it. The machine translates the movements of the telescopes into firing data and at the same time computes the lead that will be necessary to hit the flying target.

The director is connected to the gun itself by an electrical cable through which power is supplied to operate motors that control the gun's traversing and elevating gears. Thus the gun is aimed by remote control. Only the ammunition passers are normally stationed at the gun itself during action. In case of battle damage to the power supply or to the director, the men who operate the director take their posts at



Streams of fire from .50-caliber machine gun recorded by time exposure. Below, crew loading a 40-mm. gun





the gun and aim it by hand. They also serve at the gun itself when the barrel is depressed for firing at ground targets. The 40 is an effective weapon against vehicles, tanks, and torpedo boats.

Even the member of the crew who loads clips of shells into the gun becomes an automaton during battle. He stands with one foot pressed against the firing pedal, a rope tied around his ankle. To stop the gun, another member of the loading crew grabs the

Passing ammunition for 40 mm. gun which fires up to 120 rounds a minute. Note size of shell

Right, men at table in plotting room practice charting incoming enemy aircraft on the squares



Crew of 40 mm. gun takes bead on aerial target. Gun is fired by remote control or by hand in emergency



rope and yanks the loader's foot off the pedal. The loader himself can't hear the "cease fire" command above the explosions of his gun and he's too busy to watch for such an order.

The nerves of a 40 millimeter gun crew are keyed to hair-trigger action in combat areas. An aerial attack may be over almost as soon as it begins. There may be only a momentary roar and then the enemy plane hurtles past overhead, out of range and out of sight almost before the gunners can swing their weapon toward it. The automatic 40s as well as .50 caliber machine guns are scattered through areas that are within range of enemy air attack. The big machine guns, too, can tear an airplane apart with their streams of bul-

lets. Their effectiveness has recently been increased by means of a new type of incendiary bullet that sets fire to the plane upon contact and that is capable of blowing up self-sealing fuel tanks in aircraft.

Because of the suddenness with which an air attack may come, members of gun crews are always at their guns while on duty. The anti-aircraft artillery guards against surprise by maintaining an aircraft warning network that reports the presence, direction, and altitude of all enemy aircraft that are sighted from any of the observation posts. Half a minute's warning is more than enough for a gun crew to swing the gun in the expected direction, ready to open fire.

Often the guns are mounted on the roofs of buildings or on the tops of special anti-aircraft towers that provide better visibility horizons and fields of fire. In spite of the fact that they disclose their positions when they go into action, the guns are usually camouflaged. This prevents enemy air observers from detecting their locations ahead of time. A haystack in a field, an agricultural tractor, even what appears to be an ordinary house may be nothing more than a shell that is collapsed for action. Dummy gun emplacements, too, are used to fool the enemy, and the anti-aircraft crews sometimes replace the dummies with real guns, or place dummies in the concealed positions that they once used, to help keep enemy air-men confused.

A complete defense against air attack in-

Spotter at field telephone calls in alarm



Member of director crew gives alert to gunners; note optical gas mask. Below, powerful searchlight hunts air target





Roof of this dummy water tower pushes back to reveal .50-caliber machine gun

cludes an aircraft warning network, fighter planes, light and heavy anti-aircraft guns, radio detectors, searchlights, barrage balloons, and smoke pots.

Barrage balloons are a pretty effective defense against dive bombing and low level attacks. The big balloons contain hydrogen, a source of possible danger when they are hauled down to the ground for maintenance or during stormy weather. Members of the balloon crews never wear woolen shirts and they must wear hats at all times, two precautions to avoid stray static sparks that might ignite leaking hydrogen. Keeping the head covered prevents possible static accumulations in the hair. Cats and dogs are also barred from balloon

Five-man director crew wearing optical gas masks supply it with necessary data by which the machine translates movement of target to anticipate position

sites to prevent accidents from static sparks.

Rows of smoke pots can be used to blanket a whole area under a thick, low-lying fog bank that conceals specific targets from the air.

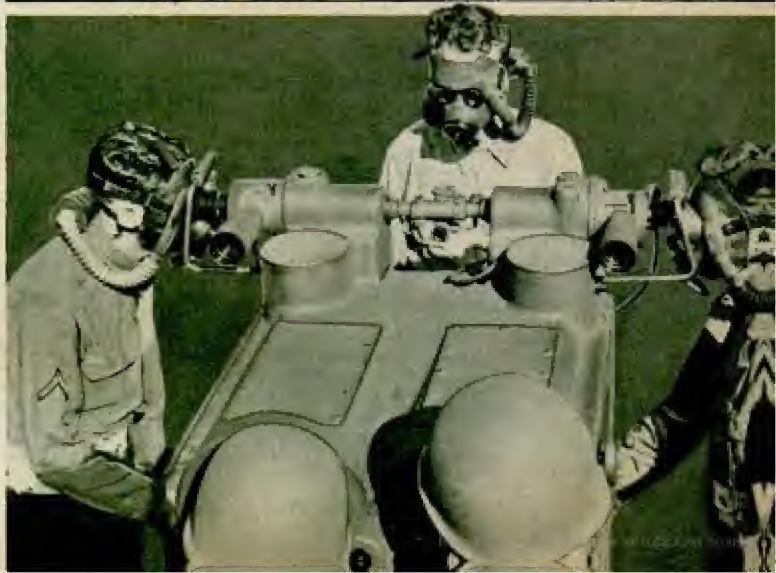
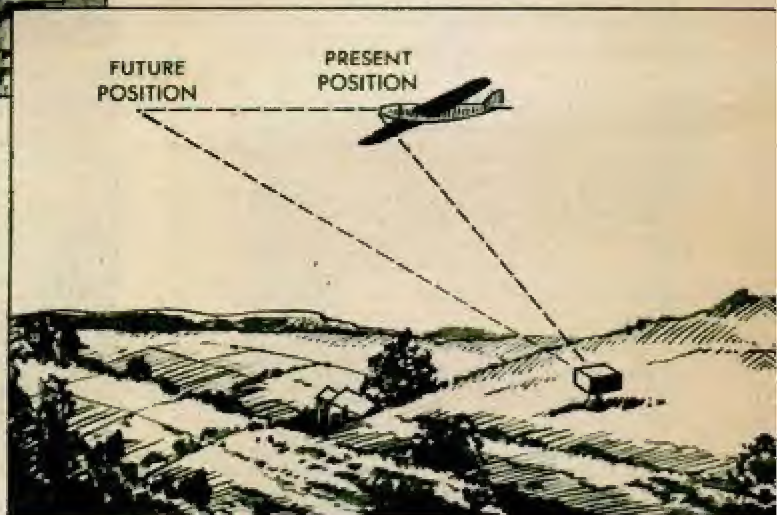
No perfect anti-aircraft defense seems to have been developed by any of the belligerents. The best techniques are to use combinations of defense weapons both to distract the attackers from their targets and to knock down so many planes that the raids become too costly to be continued.

In this respect the United States has been eating its cake and having it too. Our air raids against our enemies in many cases have been conducted with minimum losses and at the same time our ground defense units have beaten off, time after time, determined enemy attacks.

Our big armored battle planes have been riddled by anti-aircraft shell fragments without disabling them. In one phase of the African campaign 20 American bombers raided an enemy target and every airplane returned safely to its base in spite of the fact that each of them had received hits from German anti-aircraft guns.

American anti-aircraft crews always expect to make their hits count more effec-

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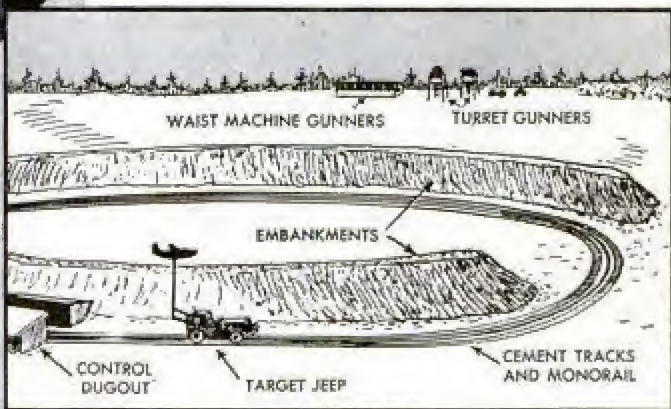
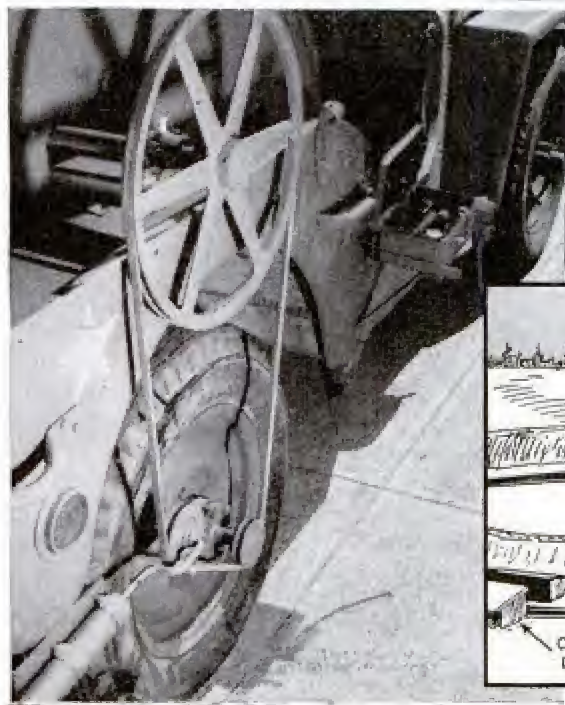
*Capt. Eugene C. Merrill, 1st Force Group
Bureau of Public Relations, War Dept 722
Washington, D.C.*

Peek-a-Boo Jeep Hauls Target for Air Gunners

All the tactical problems of combat gunnery in the clouds are simulated by the "target jeep" constructed by the Air Service Command engineers at Spokane Air Depot. By an ingenious series of gear wheels, cams and rocker extension arms, the jeep provides machine gunners and cannoneers of the Second Air Force with a small-sized target whose bobbing and weaving calls for even greater accuracy than is demanded in actual combat. The jeep's target arms rise and fall at irregular intervals, and with such rapidity that gunners must be ever on the alert to hit it. The jeep operates



Driverless jeep, guided by monorail, moves aerial target behind eight-foot embankment. Gear wheels (left) cause target to perform "combat maneuvers"



without benefit of a driver, who might be hit by splinters. It is guided by a monorail, which governs the direction of the front wheels, while two concrete rails guide the tires. The jeep runs throughout its course behind an eight-foot embankment, over which the plane target periodically bobs into view, as an eccentric cam throws the

extension arm upward. When operators in the control house on the target range wish to stop the jeep, they stick a broomhandle out to trip a lever hanging from the switch-box on its side. The target mechanism is operated from a pulley on the rear axle, and a change in these gear wheels regulates the speed of the target operation.

Chemical Turns Any Skin White; Effects Will Last Up to Six Years

Discovery of a chemical that turns skin of any color white has been announced by Dr. Louis C. Schwartz, medical director of the United States public health service. During a study of a skin disorder among Negroes employed in a leather plant, the

hands of workers wearing chemically treated gloves became white. The chemical was intended to prevent deterioration of the gloves. Later experiments on the skin of animals disclosed that the change lasted from six months to six years.

No. 1 ENEMY *on the* HOME FRONT

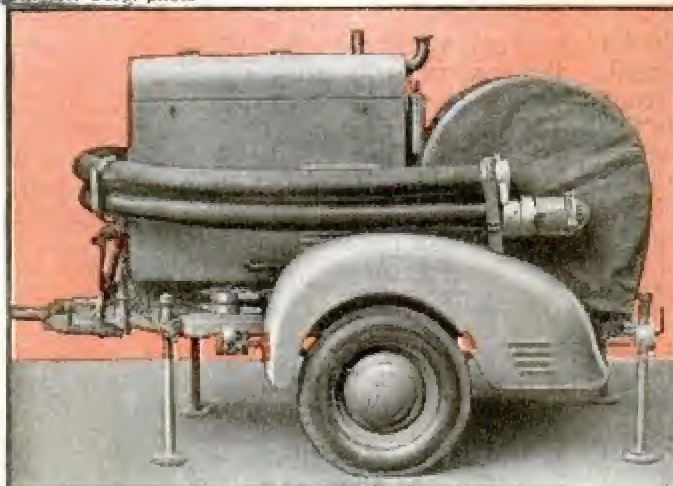


"Turret guns" atop crash truck fight test fire in gasoline-soaked fuselage at the new Douglas-Chicago aircraft factory



Asbestos-clad fire fighters on aircraft carrier can get close to blaze. Below, all-steel trailer-type fire engine is hauled behind passenger car or can be mounted on deck of a ship

Chrysler Corp. photo



HOMES that fire destroyed in one year would have housed the entire city of Los Angeles. In one month, dwellings of 395,000 persons were ruined by fire, while only 350,000 new units were built. Forest fires destroyed enough timber to build 20,000 Liberty ships. Farm buildings burned to the ground every 15 minutes. One fire alone destroyed enough flour to feed an army of 500,000 men for an entire year. Fire last year killed more Americans than died in the hills of Sicily and on the beach at Salerno.

Yet four out of every five of these fires were the fault of some single human being. That many—80 percent—result from nothing but carelessness. That many, with all the lives they cost and the property they destroyed, were preventable.

"Fire is a double waste," says Lt. Gen. William S. Knudsen, production director for the War Department. "It attacks buildings, equipment and materials. It stops production and causes waste of precious man hours. Fire can be prevented by care."

The great war plant building program admittedly increased, in some cases, the likelihood of fire. As Percy Bugbee, general manager of the National Fire Protection Association, pointed out:

"The urge for speed and production brought about the erection of buildings of huge area and of inferior construction and, in many cases, without adequate fire-protection facilities."



This does not mean that an industrial plant, just because it is new, necessarily does not have adequate fire protection. But it does show the need for additional caution.

Moreover, even in plants with all the safety devices that exist—with all the fire walls, automatic sprinklers, automatic fire alarms, watchmen constantly on the prowl and a plant fire department equipped for anything—even in such a plant fire can be the home front's worst menace. Because no fire-fighting tool ever invented was proof against that greatest of incendiaries, carelessness.

Simple things cause fires: a choked chimney, a faulty furnace, an inflammable roof; broken electrical equipment, careless handling of gasoline, a dropped cigaret, neglected rubbish piles. But a simple hazard and a simple careless act

Sea-going firemen are protected by "spray umbrella" at Navy fire-fighting school. Below, special nozzle to produce "waterfog" Courtesy Rockwood Sprinkler Co.





Courtesy American LaFrance-Foamite Corp.

Safety nozzle sprays stream of water on live circuit of 250,000 volts

may have complicated and costly results.

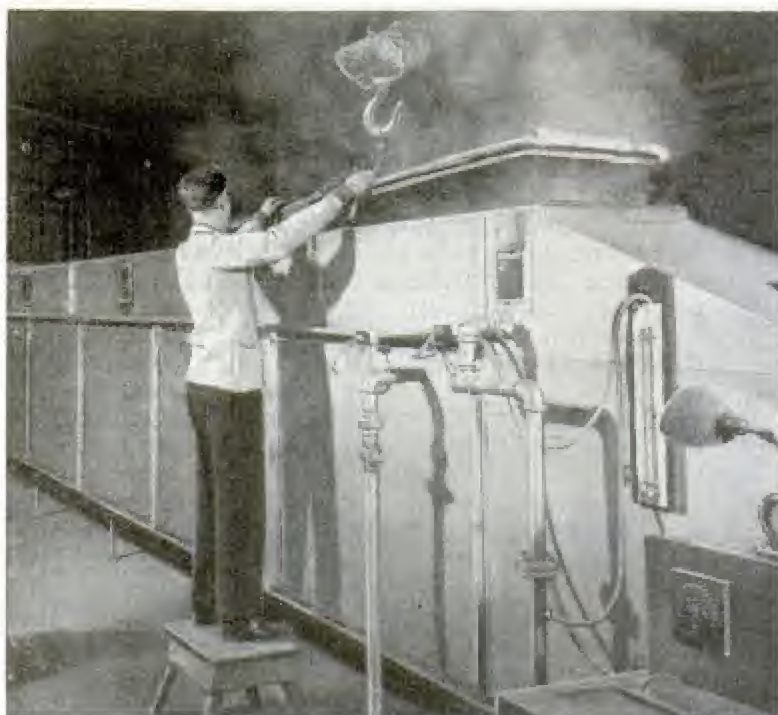
"Fire caused by carelessness and ignorance is just as effective an aid to the enemy as though it were caused by sabotage or incendiary bombs," Mr. Bugbee reasons. Which leaves it up to every individual to be his own "fire watcher," and to be just as devoted to that job as if he were actually on a rooftop, spotting the outbursts of flame from enemy bombs.

Science and industry have combined to give America unsurpassed tools for fighting this, man's most ancient enemy. But the tools are of most value when, like a football team's numerous reserves, they merely back up the people who are the real first line of fire defense.

Recent advances in fire fighting technique have seen principally an increased use of smothering agents, of sprays, and of chemicals that either combat flames directly or act as fireproofing agents.

Treated wood is lifted from test chamber by crane after exposure to flames

Photo from DuPont Co.



Use of carbon dioxide gas, which smothers flames by depriving them of the oxygen needed for combustion, has increased. Portable equipment is used, or fixed installations down which the gas, stored in highly compressed liquid form, can be channeled. One such installation developed by Walter Kidde & Co., and widely used on American and British merchant ships, features a "juke box that can smell smoke."

This is a cabinet set in the ship's wheelhouse. It contains a photoelectric cell actuated by a constant light beam. Smoke interfering with this beam sets off the fire alarm.

Pipes on the underside of each deck constantly collect air samples from every hold, and this air is drawn through the "juke box" by a fan. When smoke is detected an alarm bell rings; the location of the burning hold is indicated, and billowing clouds of carbon dioxide can be directed back into the hold down the very pipe that also acts as the smoke detector.

War plants use similar cabinets with the

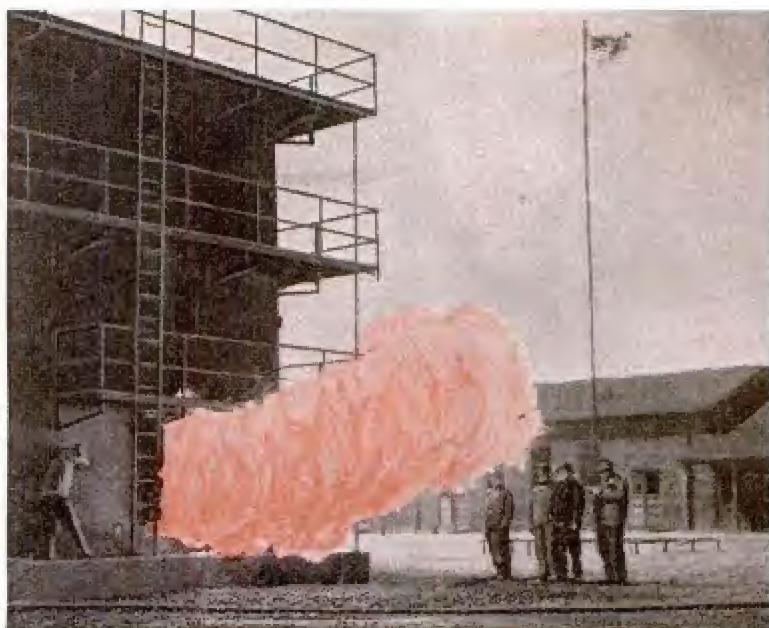
"photoelectric nose" to detect smoke. Discharging a few cylinders of carbon dioxide over the fire reduces the air's normal 21 percent oxygen content to 14 or 15 percent, and in that tenuous atmosphere few inflammable liquid fires can continue to burn. Even carbonaceous fires, involving wood, paper, cotton and the like, are so checked that spraying water on the glowing embers kills them.

The C-O-Two Company has devised a hand-grip valve that will fit any hand-type carbon dioxide extinguisher, to replace the wheel valve. With it, the gas can be turned on and off with one hand while the operator plays gas on the blaze with the other hand. The tremendous pressure within the cylinder keeps the valve tightly closed when the grip is released.

Another method of smothering stubborn fires, developed by the Pyrene Manufacturing Co., is said to enable the fireman to manufacture on the spot 350 gallons of fire-smothering foam from only 19 gallons of water and one gallon of "Phomaide" solution. Water is brought from hydrant, suction or booster tank, through the hose line, and the foaming solution, carried in

Smothering "spill" fire spreading in stream of oil with carbon dioxide gas from portable extinguisher

Courtesy Walter Kidde & Co.



Fighting flames from explosion during test. Below, torch fails to ignite a fireproof blackout curtain
Courtesy DuPont Company





Courtesy John Bean Mfg. Co.

Fine spray from fire fighter gun protects fireman

a tank on the fireman's hip, is mixed with water and air in a special play pipe to form the foaming clouds.

Both foam and high-pressure spray are utilized in airport crash trucks to fight stubborn gasoline and lubricating-oil flames that may spread from a cracked-up plane. The John Bean Manufacturing Company, a division of the Food Machinery Corporation, uses extremely high pumping pressures to create a fog that is said to quench flames with utmost speed, at the same time minimizing water damage.



Courtesy C-O-Two Fire Equipment Co.

Slight squeeze opens valve of extinguisher. Left, "waterfog" during test
 Courtesy Rockwood Sprinkler Co.



and smothering effect of the misty clouds.

A development of the American-LaFrance-Foamite Corporation is a spray gun for the standard hoseline, producing any stream required from a straight, full-pressure one to a full curtain of mist. Another is a nozzle that permits firemen to play water safely on electrical equipment with a charge of as high as 250,000 volts.

Normally, of course, water could hardly be applied with safety by

Rockwell-Barnes Co.
35 E. Wacker Dr.
Chicago 1, Ill.

"Rock-a-Bye" File Saves Space And Speeds Work of Operator

77832

hand hose on live electrical equipment because the water itself conducts electricity. The company's "Poweron" nozzle is said to be safe at distances of only a few feet, and at low pressures.

Similarly, the same company's 100-pound "Alfite" engine is a piece of portable equipment approved for use on electrical fires.

Rockwood Sprinkler Company manufactures equipment that makes it possible to use ordinary water on flammable liquid fires. It comes as fixed piping for such hazards as quench tanks, dip tanks, transformers, dryers, and the like, and as a portable nozzle or applicator that can be used directly on a fire hose line.

The future for such fine sprays in firefighting is thus summarized by Rockwood spokesmen:

"In addition to playing a major role in our war activities, we believe that Waterfog will revolutionize fire fighting after the war, when the men who are being trained by the Navy and who are using Waterfog to control and extinguish dangerous flammable liquid fires at sea are returned to civil life."

Chrysler is turning out in mass production an all purpose fire engine that can be hauled as a trailer behind an ordinary passenger car or placed intact on any other sort of mounting, such as the deck of a barge or ship. These miniature fire-fighters are of especial value in areas subject to air raids, for many of them can be spotted advantageously at minimum cost.

They comprise an engine with an automobile rating of 115 horsepower operating a pump of 500-gallons-per-minute capacity at 120 pounds pressure, or as an alternative, 250 gallons a minute at 200 pounds pressure for fires demanding a very powerful stream. Generally carried are two sections of suction hose and 500 feet of 2½-inch standard fire hose, and a variety of nozzles.

The engine and pump unit is mounted on skids so that it may be placed in a two-wheeled, steel-framed trailer. London uses several thousand similar small-sized pumpers for air raid service.

Control of fire should also emphasize prevention, according to

(Continued to page 152)

Reaching for folders in rear is eliminated with rocker compartment that permits the folders to be removed sideways from case



Considerable savings in floor space and in the time of filing personnel are claimed for the "Rock-a-File" cabinet, with compartments that open sideways. The whole inner compartment rocks through a quarter turn. Time is saved, the maker says, through quicker action, by the elimination of vertical lifting of filing folders at arm's length, and the end to stretching to reach rear folders. Folders are slid out sideways. With more than one operator working on the files, there is less interference, and the operators are able to work closer to the folders. Compartments may be left open—all day if desired—to reduce the total muscular effort. The saving in floor space is credited to the relatively small projection of the compartments when swung out, as compared with drawer-type files. The fact that the weight of the filed material is always well within the file shell is said to prevent overbalancing.

Some woods, such as red oak, are so porous that it is possible to blow out a candle through the wood.

Trailers Carry Big Bombs

Blockbusters, two- and four-ton bombs whose blasting effect is proved by reconnaissance photos to reduce huge urban areas to rubble, are trundled aboard R.A.F. night bombers in cradles of heavy steel. The huge bombs look like nothing so much as inoffensive railway tank cars, but their cylindrical sides contain from 4,000 to 8,000 pounds of steel and powerful high explosive. Lancasters of the Royal Air Force have been used with particular success to transport these bombs over the walls of Hitler's "European Fortress."



'Locomotive' Truck Pushes Eight Cars Along Rails

With a converted undercarriage, a U. S. Army truck is pushing freight on a railroad in England. Before it started doubling for a locomotive, the truck was an ordinary two and a half ton vehicle. It pushes seven or eight freight cars along a road operated by the U. S. Army railroad unit. This group is composed of well-trained men who formerly worked for railroads in the states.



Shining Fluorescent Stars Dot Celestial Sphere

By cementing together two astro-domes, the translucent "bubbles" through which navigators on bombers take their bearings, Lt. Col. J. E. Davis of Wright Field made a unique celestial sphere. The stars appear as they do when one looks up at them from the ground if you peer through the plastic sphere. Ordinary celestial spheres show the stars from a position looking down at them from outside the universe. Col. Davis drilled holes for the star positions and filled them with fluorescent material.





The CRAFTSMAN

"Duration" PUMP CAR is all wood

There's no reason why junior can't have a pump car due to metal priorities because you can make an all-wood model. However, for axles and bearings, it's best to find some scrap pieces of flat iron and some $\frac{1}{2}$ -in. rod or carriage bolts



By Charles and Bertram Brownold

IN BUILDING this pump car you start construction with either the wheels or the framework, but the latter and the rear wheels must be assembled together. The two rear wheels, which function as a single unit, each consist of four $\frac{1}{4}$ -in. disks of hardwood—or waterproof plywood, if you are able to get it. The disks are cut slightly oversize on a scroll or band saw, then glued together under pressure as shown in Fig. 3, using waterproof glue and arranging the disks so that the grain of each one will run at right angles to that of adjacent ones.

Small scraps of wood under the jaws of the clamps will prevent marring the work. After the glue has dried thoroughly, the disks are turned to exact size on a lathe, and two 1-in. holes are bored through each wheel according to the dimensions given in Fig. 6; the center holes to take the axles and the others to take the crank pin.

Then you assemble each wheel to a side frame member with a turned hardwood axle and a wooden washer, shown in Fig. 4, fastening the axle in the center hole of the wheel with glue, and using a hardwood wedge to spread the slitted end of the axle as shown in Fig. 1. In this all-wood design,



Fig. 1: Wooden axle, slipped through frame, is glued and wedged to rear wheel. Fig. 2: Frame showing handle and axle pivot holes

Fig. 3: Glue-coated disks of $\frac{1}{8}$ -in. hardwood, with grain running at right angles, are clamped together securely to form a wheel. Fig. 4: Closeup view of a rear axle and wedge to spread slitted end in wheel

the axles are intended to turn in the frame members. Naturally both must be hardwood so they will last as long as possible. To assemble the rear wheels and the connecting rod between them, the latter is slipped over the crank pin, a wooden washer being placed on either side of the connecting rod, after which the crank pin is secured to each wheel with glue and wedges as was done with the axles.

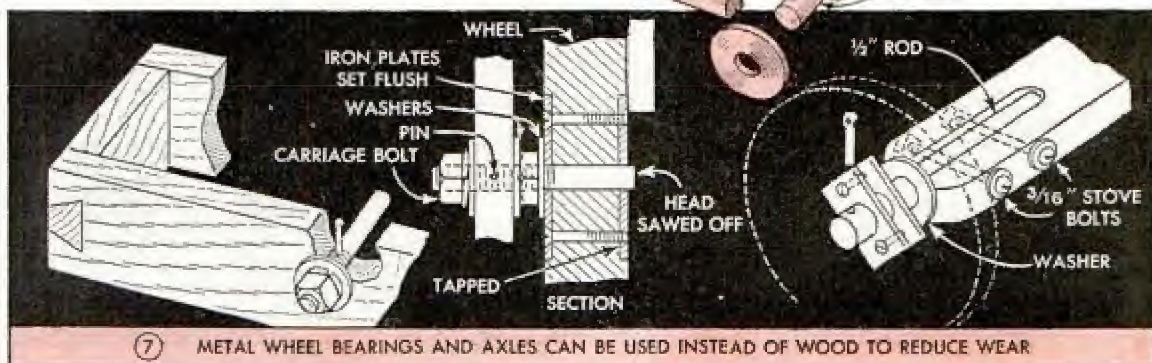
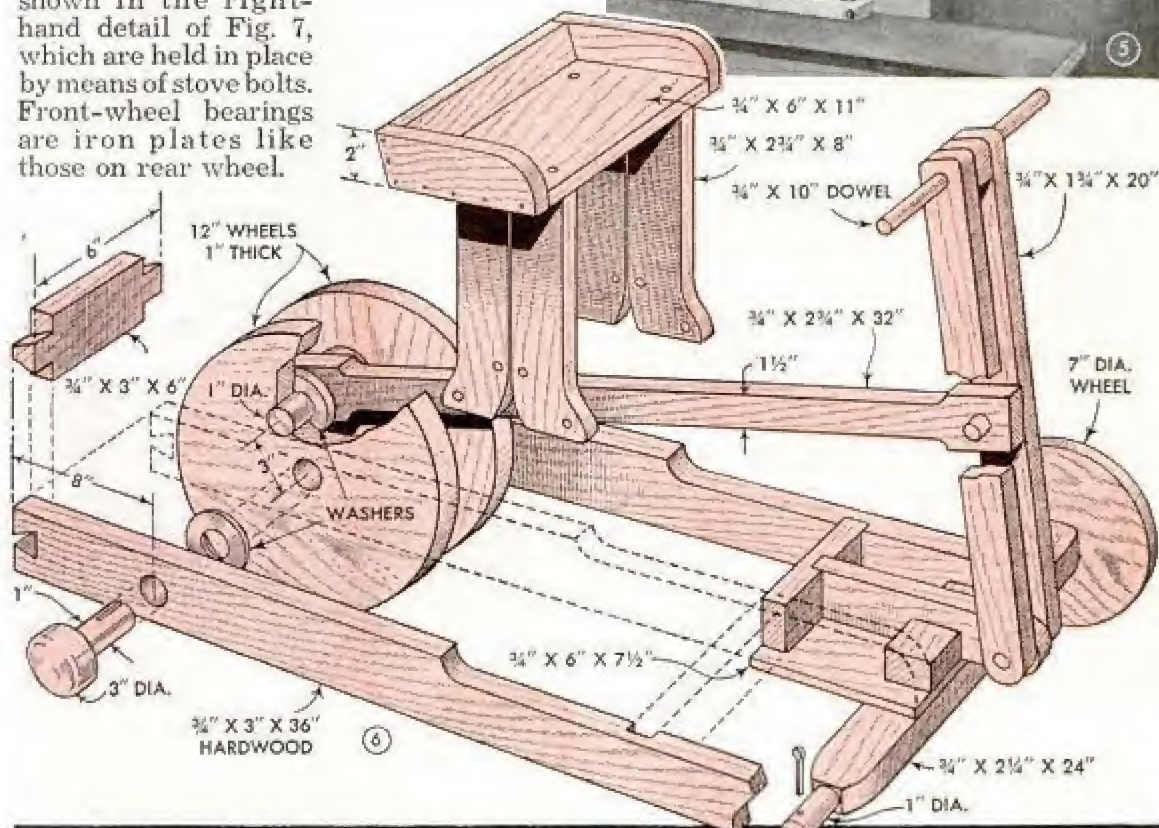
Assembling the front and rear pieces of the frame to the side members comes next, which is followed by the installation of the handle, front axle and wheels, and the seat, all of which are detailed in Fig. 6. The assembly of the front portion of the frame is shown in Fig. 2. Notice the hole for the pivot pin that holds the front axle. The pin is glued and wedged in this hole, and a cotter pin is inserted through the lower end of the pin to keep the axle from slipping off when the car is lifted.

When wooden axles and pins are used in wooden bearings, the bearing holes should be slightly oversize to avoid "freezing" of the axles or pins due to their swelling caused by absorption of moisture. Soaking the axles and pins in hot, melted paraffin will reduce the absorption of moisture. If holes in the frame members and wheels are bored with a hand brace and bit, clamping the parts down horizontally on a bench and using a small try square as shown in Fig. 5, will help in boring the holes true.

Fig. 7 shows how $\frac{1}{2}$ -in. carriage bolts can be used for axles and how small iron plates attached to the wheels can be arranged as bearings. Note from the center detail that the heads of the bolts used for the rear axles are cut off and that the threaded portion of each bolt is fastened firmly to the frame with two nuts, washers and lock washers. A pin through the frame locks the axle in position. In this assembly

the wheels turn on the axles. The rear wheels will not slip off their axles, nor will the axles project far enough inside the wheels to interfere with the connecting rod, if spacing of the parts is carried out with care, measuring all distances accurately between the frame members and the rear wheels, and also between the rear wheels themselves. Washers on each side of the connecting rod should center it and give it slight clearance. As individual thicknesses of each assembly may vary slightly, exact dimensions as given may have to be varied somewhat to suit. Two iron plates are recessed in each wheel directly over its center. These are held together by two flat-head bolts, the heads of which fit flush on one plate. The other plate is drilled and tapped to receive their threaded ends.

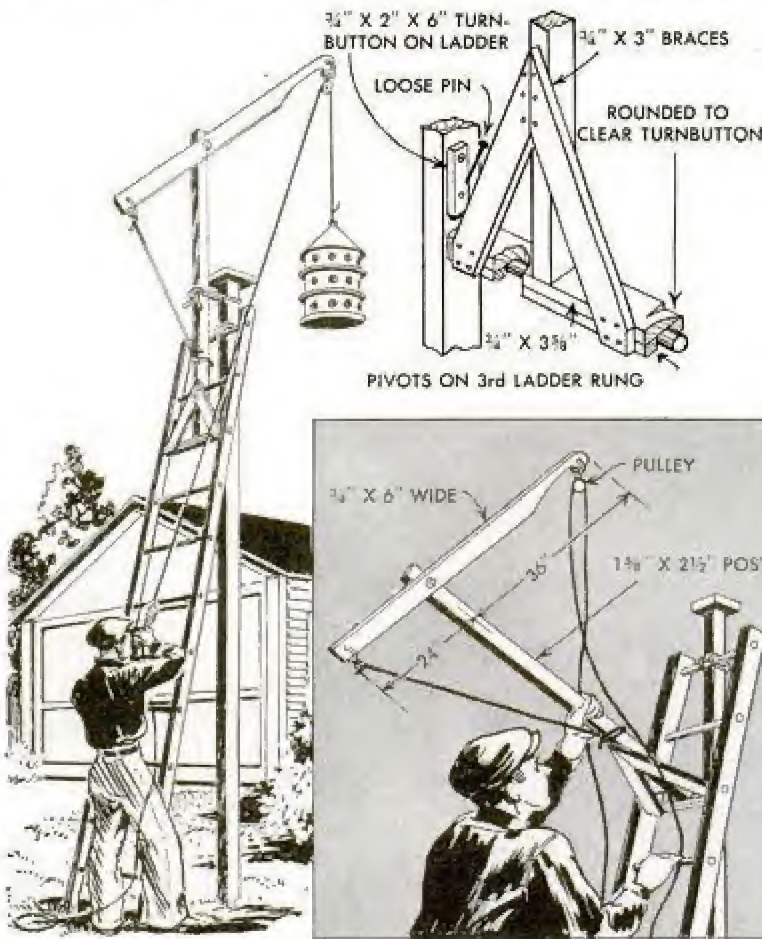
The wooden front-wheel axle is slotted or drilled to receive lengths of $\frac{1}{2}$ -in. rod or sawed-off portions of carriage bolts as shown in the right-hand detail of Fig. 7, which are held in place by means of stove bolts. Front-wheel bearings are iron plates like those on rear wheel.



Ladder Hoist Swings Heavy Birdhouse on Pole

If you have occasion to put up or take down a large birdhouse, or do other light hoisting jobs, this simple hoist and a ladder will enable you to do the work easily. As shown, the hoist is supported on a rung of the ladder where it is held by turnbuttons and two cleats nailed to the underside of the horizontal support piece. A cross-arm or crane is bolted to swing on an upright, which can be any desired height. In use, the cross-arm is held at the desired angle by a rope tied to the upright, while the latter is tied to the birdhouse pole, the ladder also being tied to the pole. After the house has been raised to the necessary height, the hoisting rope is tied to the ladder and the rope which secures the hoist is let out until the hoist swings back far enough to ease the house into position.

—A. L. Mills, Chicago.

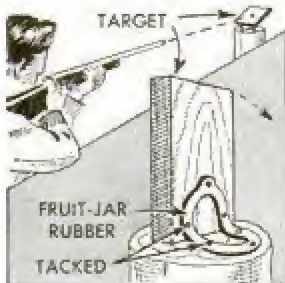


Trouser Hanger Serves as Gluing Clamp for Light Work

When there is no other clamp available, a trouser hanger comes in handy for holding small work while the glue dries, or when it is necessary to clamp work together for trial assembly. After slipping the hanger over the work, move down the small ring on the hanger hook to press the jaws of the hanger firmly against the work.

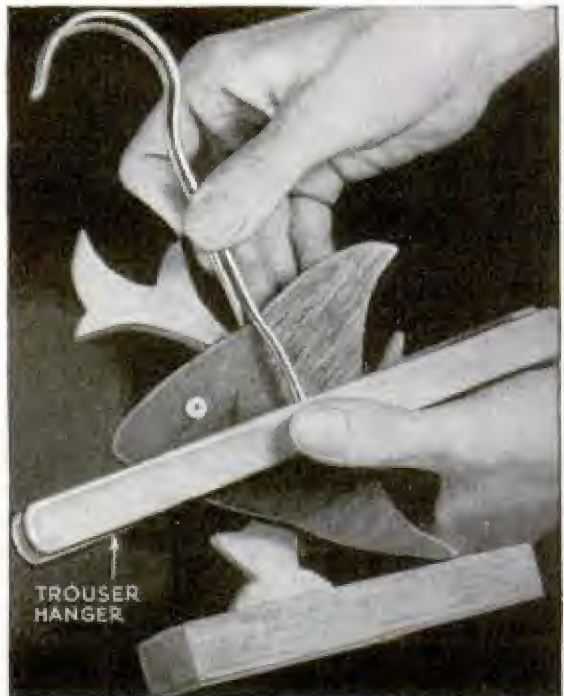
—Wm. Swallow, Brooklyn, N. Y.

Air-Rifle Target Is Self-Setting

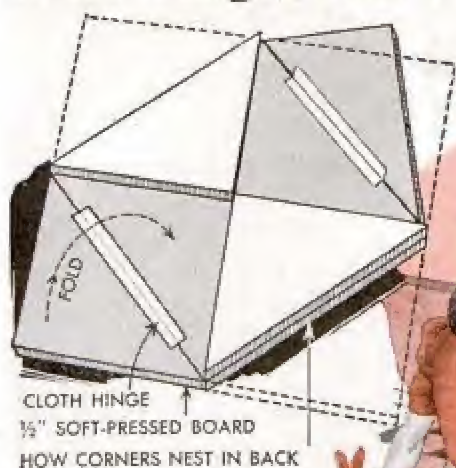


A small block of wood and a discarded fruit-jar rubber are all you need to make this simple self-setting target. Use the rubber as a hinge and mount the target on any suitable support. The

target must be light enough for the rubber to return it to vertical position when hit.



Dart Target Has Folding Back for Easy Storage



Have you often wished that the target for your dart game was larger so that poorly aimed darts would not mar the wall, or their pointed ends become dulled by striking the wall? If so, you can increase its size without making it bunglesome to store by fitting it with hinged sides, which can be folded against the back of the target to form a compact unit for storage. To make the sides, take a piece of soft-pressed board, the kind used in insulating work, of the same size as the target and cut it diagonally from opposite corners. This will give you four triangular



pieces which are hinged to the target edges with cloth tape. Hang the target as indicated in the upper right-hand detail.

—R. Boettinger, Englewood, N. J.

Self-Closing Tool Box is Handy on Garden Wheelbarrow

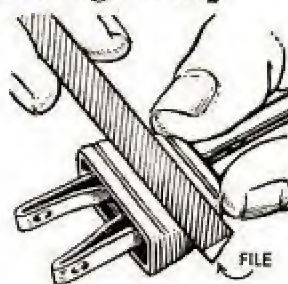
To keep small gardening tools at hand when needed, pivot a box made of light



wood between the legs of your wheelbarrow. Make the box to the shape indicated and pivot it off center, placing the pivot screws near the front edge. The weight of the tools then will serve to hold the box closed. Stops at the upper edge keep the box from tipping too far forward.

Grooves Filed in Electric Plug Provide Firm Finger Grip

Flat plugs on the ends of some electric appliance cords often are difficult to grip firmly enough to pull them from wall receptacles. However, if several grooves are filed in the sides of the plug as indicated, a surface that can be gripped firmly is provided.



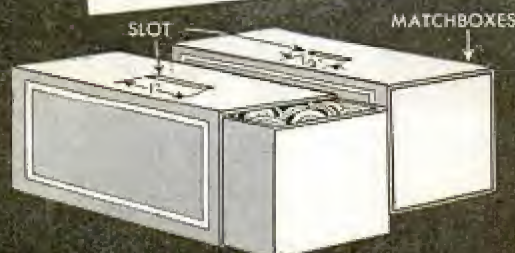
Solving HOME



A wire-type fireplace screen placed over a wall register or near a radiator provides a convenient rack on which to place small laundered articles to dry



A small child can be prevented from completely removing its shoe laces by tying knots in them between the second and third holes as shown



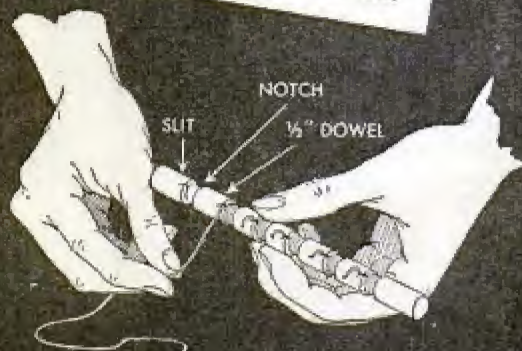
Match boxes with slots cut in the tops and tabled for size and color make neat button "banks" to keep in your sewing cabinet



Lemons will keep much longer if they are given a light coating of melted paraffin which may be applied with a small brush

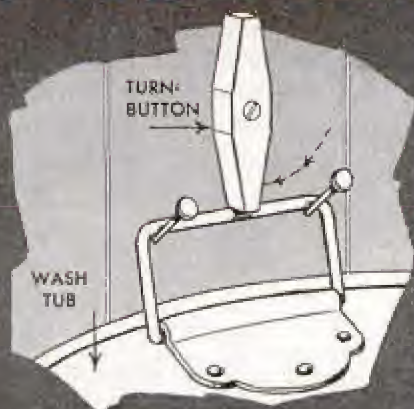


To keep a ball of yarn from rolling on the floor when quilting, slip it over a curling iron and clip the tongs to the quilt cloth



Save tag ends of embroidery threads for future mending by wrapping them on a notched dowel. A slit at each notch prevents unwinding

PROBLEMS



A washtub hung on the outer wall of a building won't rattle if a wooden turn button is provided to wedge tightly against the handle of the tub



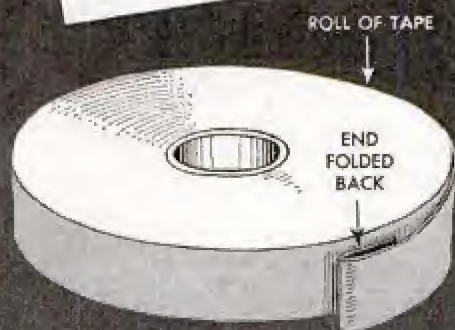
Repapering data, such as rolls needed and room measurements, are always at hand if they are written on the back of a wall picture hung in the room



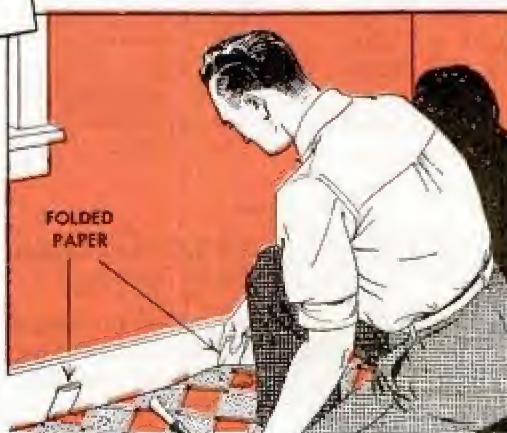
Hinges will need oiling less frequently if the pin has a flat spot filed on one side as indicated to serve as an oil reservoir



Porch joists will be protected from moisture when the floor is scrubbed, if they are covered with strips of roofing before flooring



By folding under the end of cellulose or other tape before pressing it against the roll, it will come free easier when next used



"Handles" of folded newspaper placed under the edge of linoleum, facilitate lifting it when fitting against a wall for trial

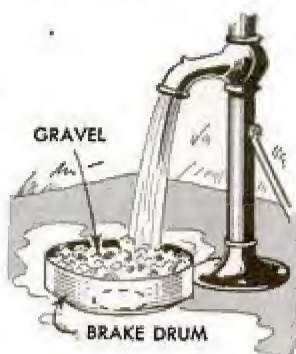
Glass Cutter Is Kept in Condition By Storing It in Oil



The wheel of your glass cutter will stay free of rust and roll more easily if it is kept in a test tube containing a mixture of light oil and kerosene. A cork to fit the test tube is placed on the cutter handle as shown and secured with sealing wax. The cork remains on the handle when the cutter is in use and seals the tube as soon as the cutter is put away.

Splash Pan Under Well Pump Is Self Draining

Filled with coarse gravel, an old brake drum makes a good pan under a well-pump spout to prevent water from splashing. Weight of the gravel will keep the drum in place, and the hole allows water to drain away.



Paper-Wrapped Package Opened Safely With Tracing Wheel



Use of a dress-maker's tracing wheel for opening merchandise wrapped in heavy paper bags or bundles is less apt to damage the contents of the package than use

of a knife. The wheel cuts a perforated line through the paper which permits it to be torn open without difficulty and in the shortest possible time. Use of a knife for this work often results in cutting or destroying the contents of the package.

Cleaning Steel Square With Putty Removes Dirt From Markings

If your steel square or rule has become soiled with dirt or grease so that the indented markings are hardly visible, you can do a thorough job of cleaning them by dabbing and rubbing the surface with a small ball of putty. This is used somewhat like wallpaper cleaner.



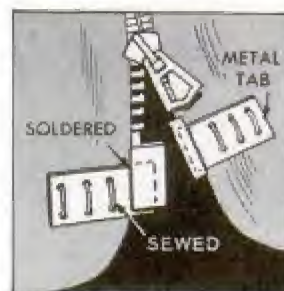
Poultry Rings Decorate Purse



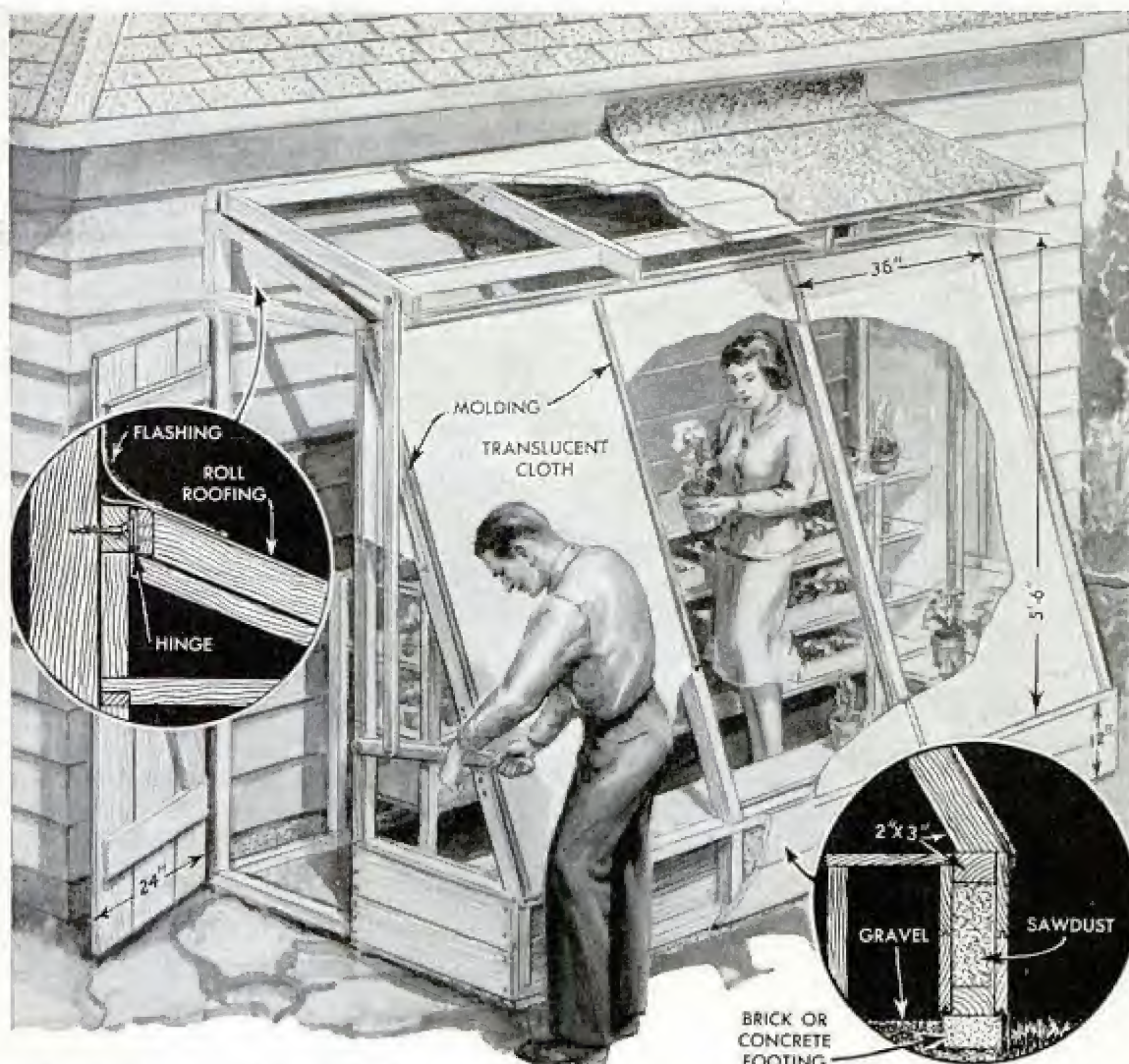
You can obtain durable, novel and decorative pulls for slide fasteners on pocketbooks by using a plastic poultry leg marker. The rings are available in many bright colors and can be combined into necklaces, bracelets, small individual key rings and are useful for many other purposes which you can devise.—Benjamin Nielsen, Aurora, Nebr.

Simple Repair for Slide Fastener Saves Valuable Garments

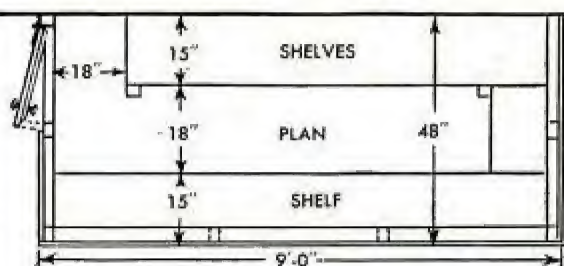
It isn't necessary to throw away an expensive jacket just because the slide fastener has torn loose at the bottom. It may be repaired by prying open the small starting tabs at the lower end of the fastener and inserting metal strips, which have been punched so that they may be sewed to the garment, into the tabs, as shown. Then the tabs are closed on the strips with a pair of pliers and soldered. With this repair, the ends are held firmly in place and will not pull loose from the garment.—R. Kottmeier, Hamilton, Ont.



Roomy Hothouse Has Sides of Translucent Cloth



Inability to purchase good building materials should not prevent construction of this inexpensive hothouse because all the materials are readily available. For framing, short lengths of stock can be obtained at your local wrecking yard. All the open panels of the frame are covered with translucent cloth, which is inexpensive and available from mail-order houses at a few cents per square foot. The cloth is attached with tacks, which are then covered with light wood molding. The roof, covered with tar paper, is small and light and is hinged to raise for ventilation by means of a lever at each end. These are adjustable and are held in the desired positions by pegs stuck in holes drilled in the corner studs. Side-walls are only a foot high and are insulated with sawdust as shown in one of the details. The sills should be creosoted and set on a brick or concrete footing. Shelves are provided inside as shown. In severely cold sections the translucent cloth could be



installed on the inside of the framing as well as on the outside, forming an air space between. This type of cloth retains heat better than glass and is durable and waterproof. Heating depends on the weather of your locality. In extremely cold districts a small stove may be necessary. In milder localities, a small electric heater, of the type having a fan and controlled by a thermostat, will maintain the required temperature through winter nights when only a little heat is necessary.

HONOR

for our

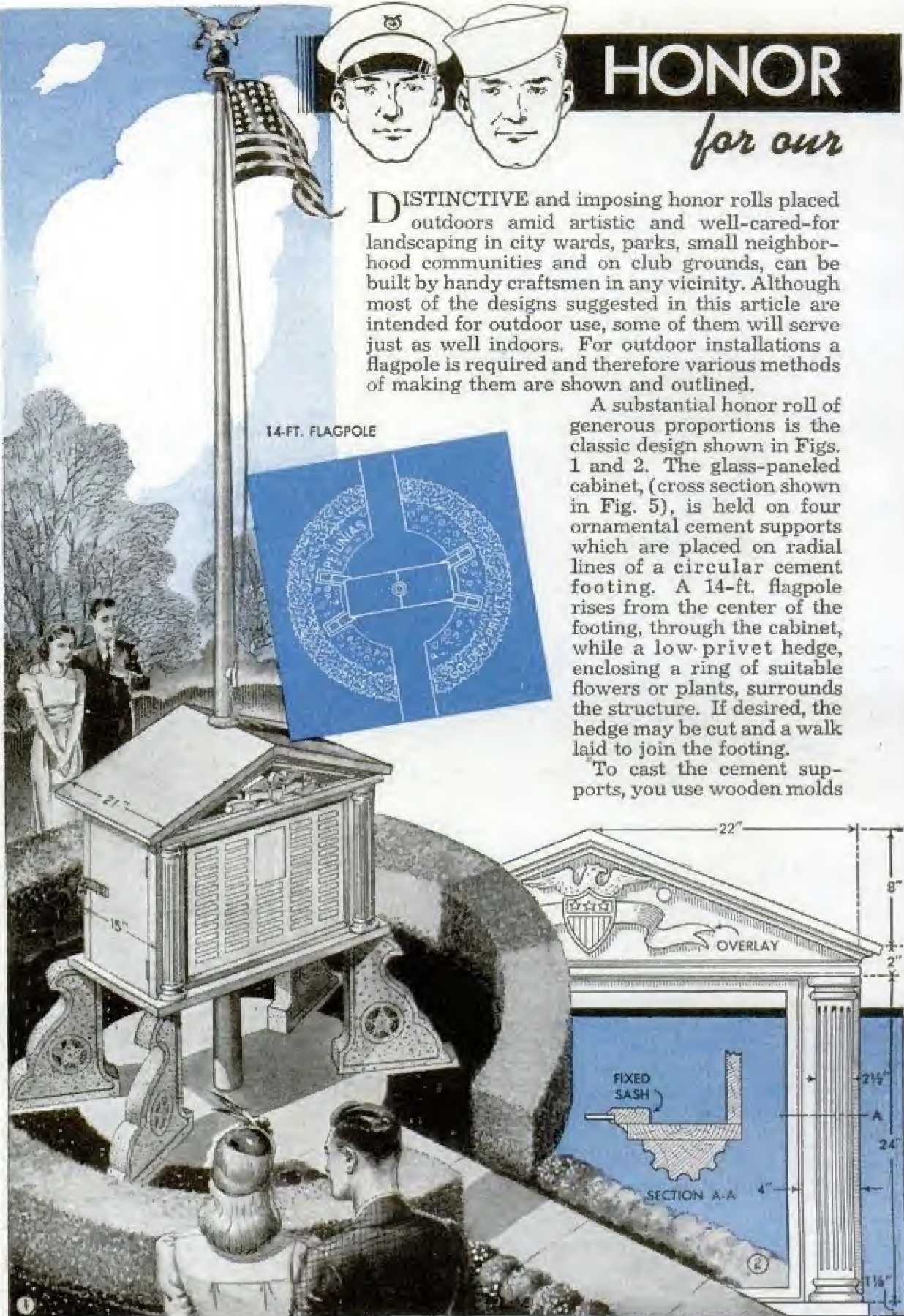
DISTINCTIVE and imposing honor rolls placed outdoors amid artistic and well-cared-for landscaping in city wards, parks, small neighborhood communities and on club grounds, can be built by handy craftsmen in any vicinity. Although most of the designs suggested in this article are intended for outdoor use, some of them will serve just as well indoors. For outdoor installations a flagpole is required and therefore various methods of making them are shown and outlined.

14-FT. FLAGPOLE



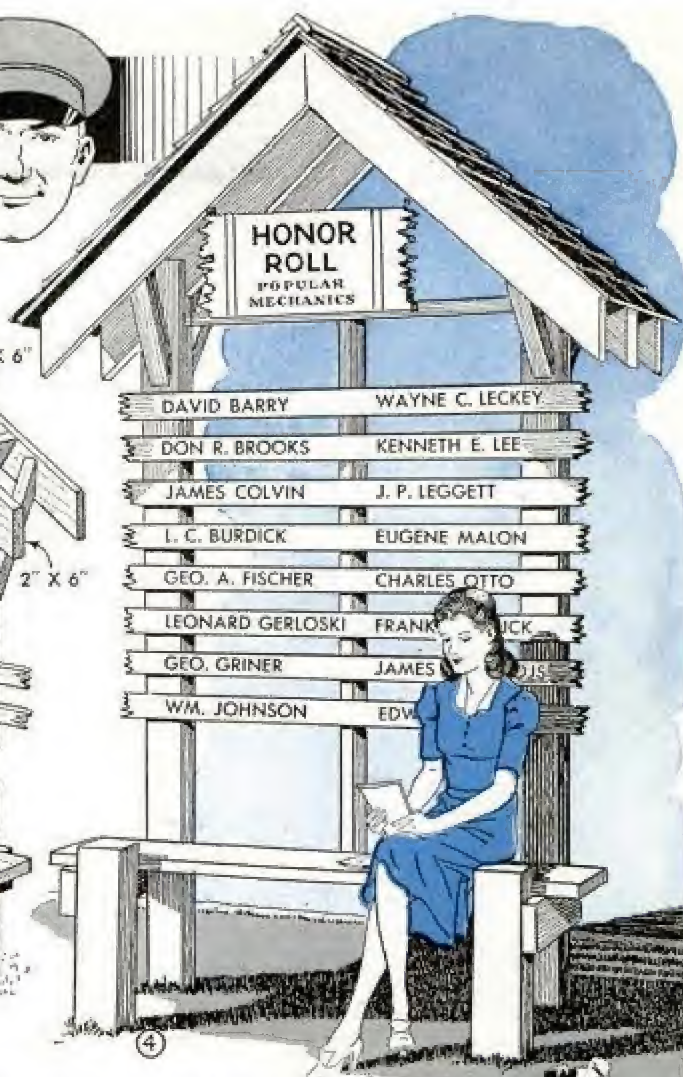
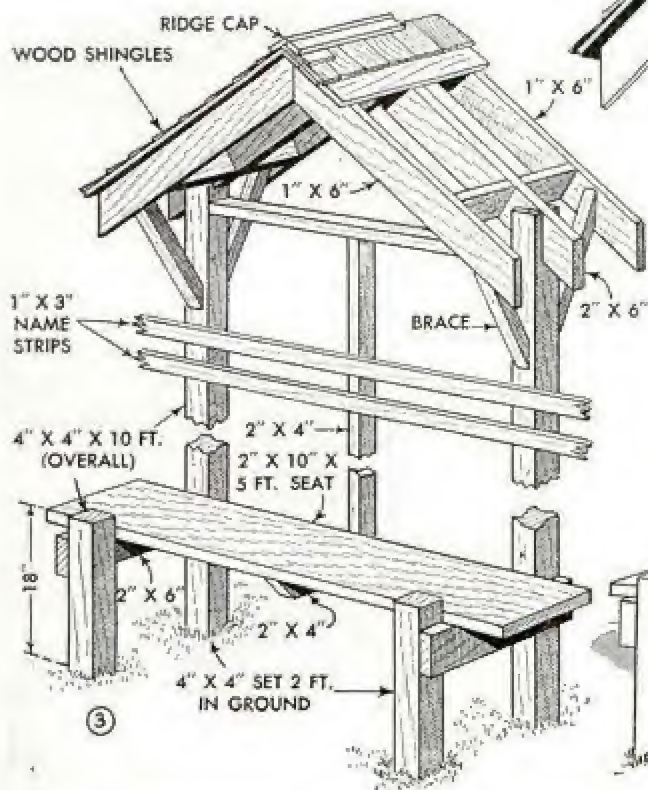
A substantial honor roll of generous proportions is the classic design shown in Figs. 1 and 2. The glass-paneled cabinet, (cross section shown in Fig. 5), is held on four ornamental cement supports which are placed on radial lines of a circular cement footing. A 14-ft. flagpole rises from the center of the footing, through the cabinet, while a low-privet hedge, enclosing a ring of suitable flowers or plants, surrounds the structure. If desired, the hedge may be cut and a walk laid to join the footing.

To cast the cement supports, you use wooden molds

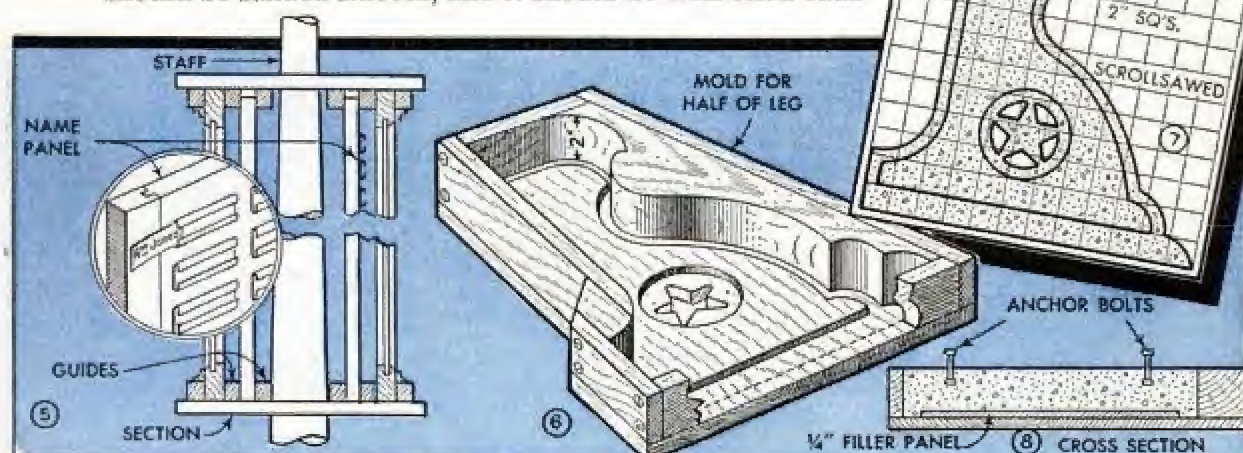


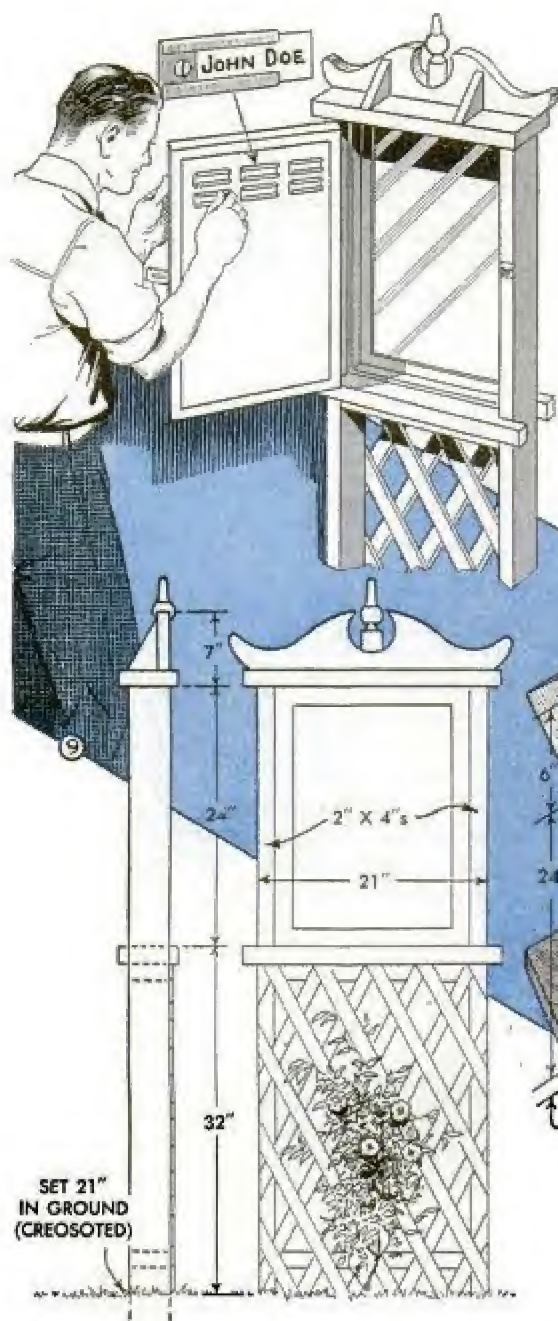
ROLL

boys...



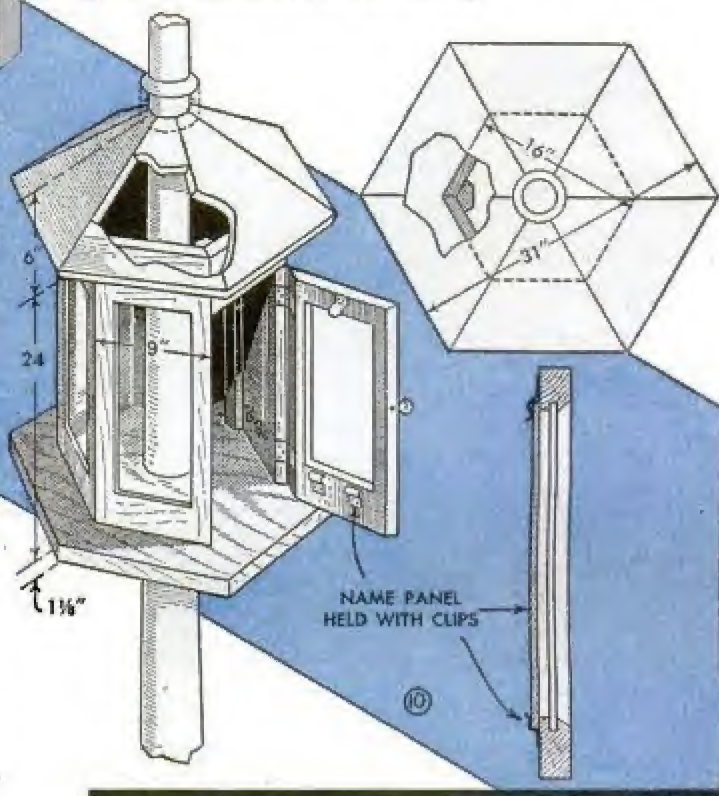
detailed in Figs. 6, 7 and 8. The supports are cast in halves; hence left and right molds are required. Edges of the molds are scrollsawed from 2-in. stock, and a panel of $\frac{1}{4}$ -in. stock is cut out to conform to the mold outline and to include a star in a circle. Be sure to bevel the edges of the $\frac{1}{4}$ -in. stock to provide sufficient "draft" to permit easy removal of the form. Notice how the sides of the mold are screwed together so that they can be removed easily in 48 hrs., when the concrete has set hard. All wood to contact the cement should be sanded smooth, and it should be well oiled each



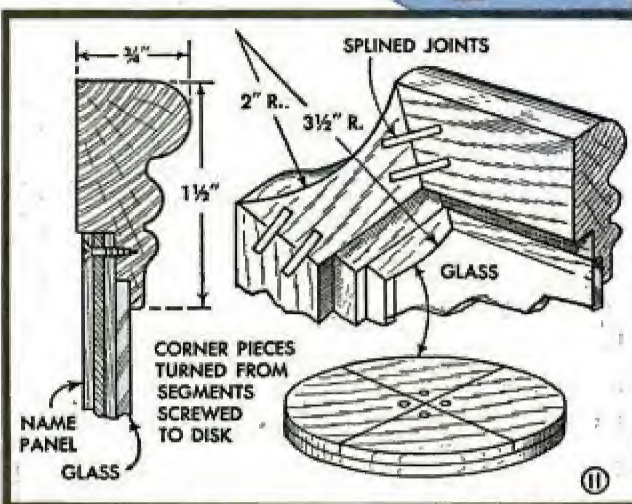


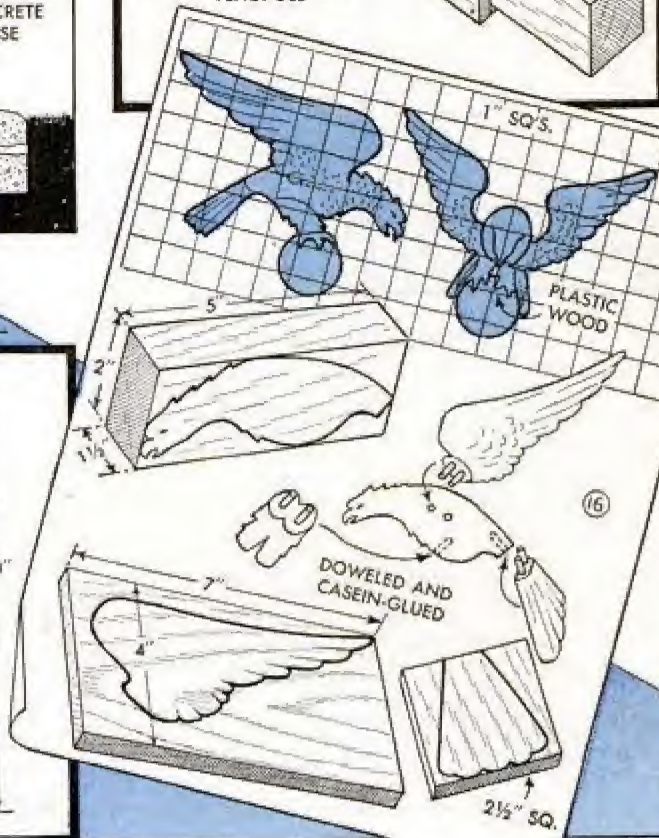
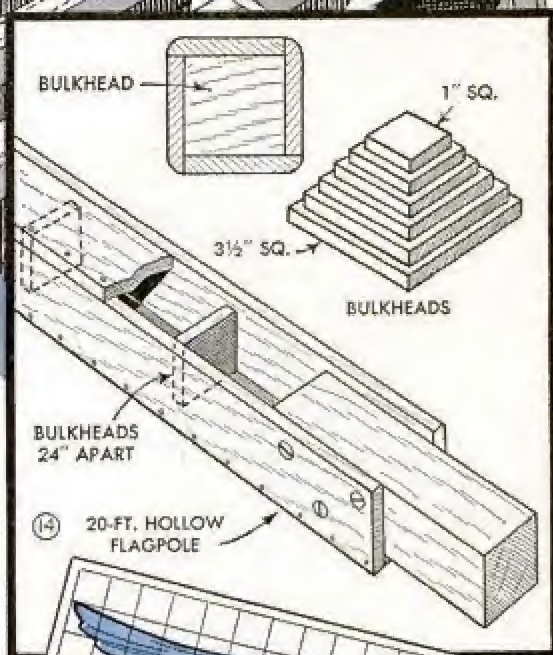
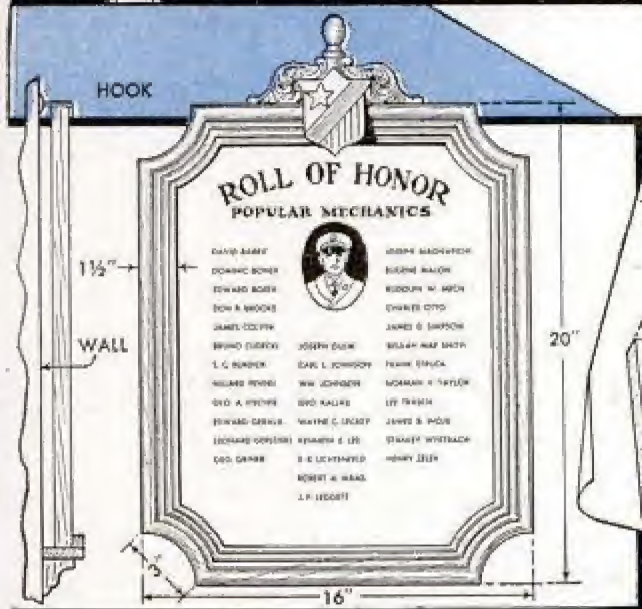
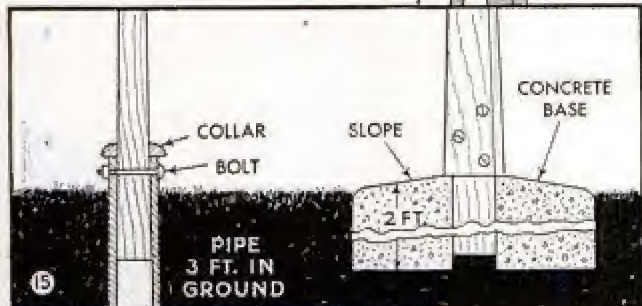
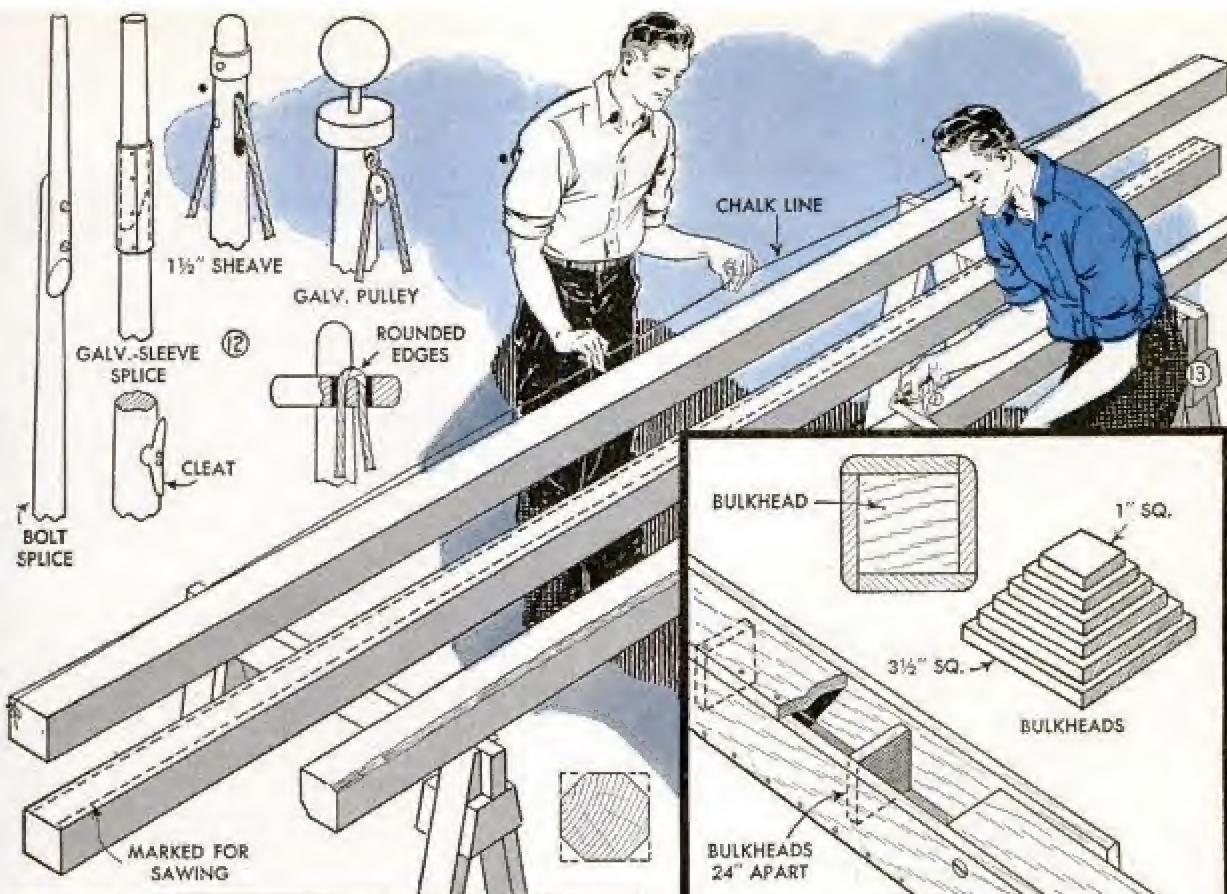
latter are permanent sash, while the ends are hinged so that they can be opened to permit removing the name panels which slide between guides. The roof may be covered with canvas or other waterproof fabric and painted, or it may be covered with roofing paper.

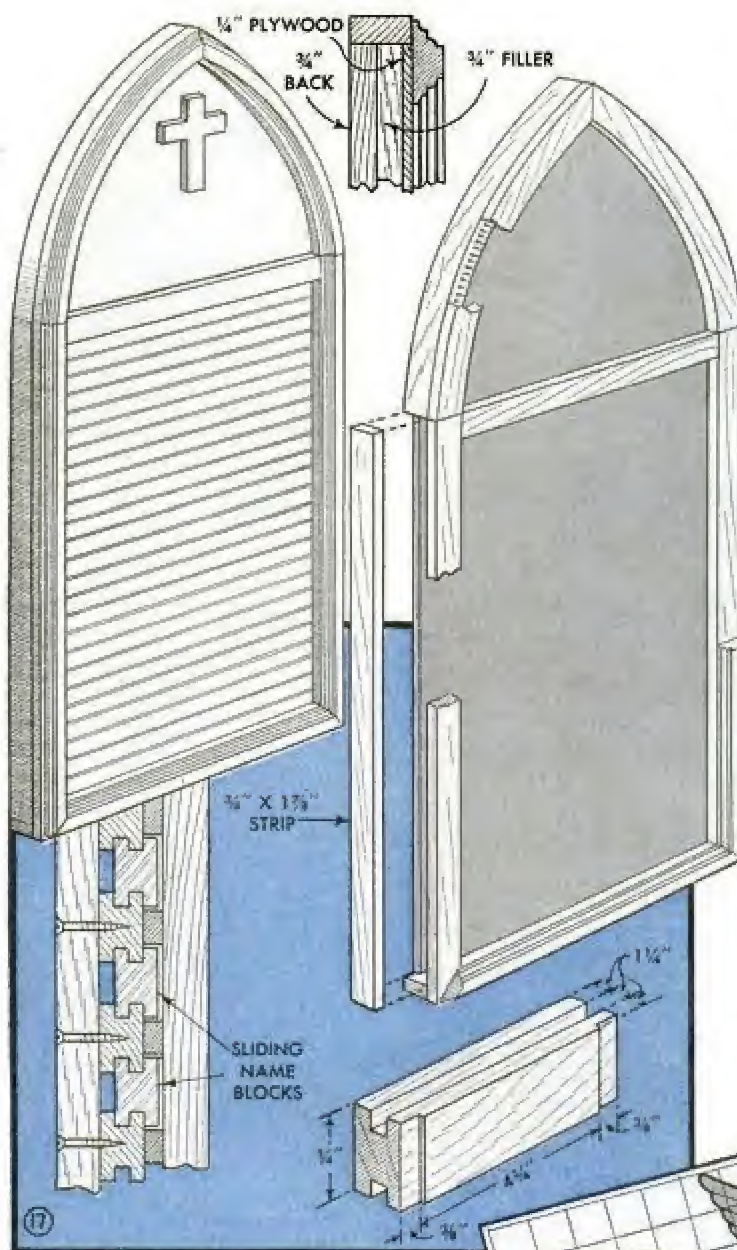
Figs. 3 and 4 show a simple rustic type of honor roll combined with a seat and provided with a narrow roof. In this case the names are painted on 1 by 3-in. strips, previously stained and coated with spar varnish. When wood is set in the ground it should extend below frost level to prevent heaving caused by alternate freezing and thawing, and the portion in the ground should be well soaked with creosote to prevent the wood from rotting.



time the mold is used. Proportions for the mix are cement, 1 part, torpedo sand, 3 parts, measured by volume. Add water to produce a heavy mush—not too "runny." Shovel the mix into one of the molds, tamping well, and when the mold is filled flush force in two bolts as shown in Fig. 8. These bolts are used to hold the two halves of the casting together. As soon as the cement has set sufficiently to permit bringing the flat inside surfaces of the castings together, one mold is placed directly on the other so that all outside edges are in perfect alignment. When the cement has set hard, the two slabs will be one unit. Bolts must be installed also in the top to permit attachment of the cabinet. Front and back of the





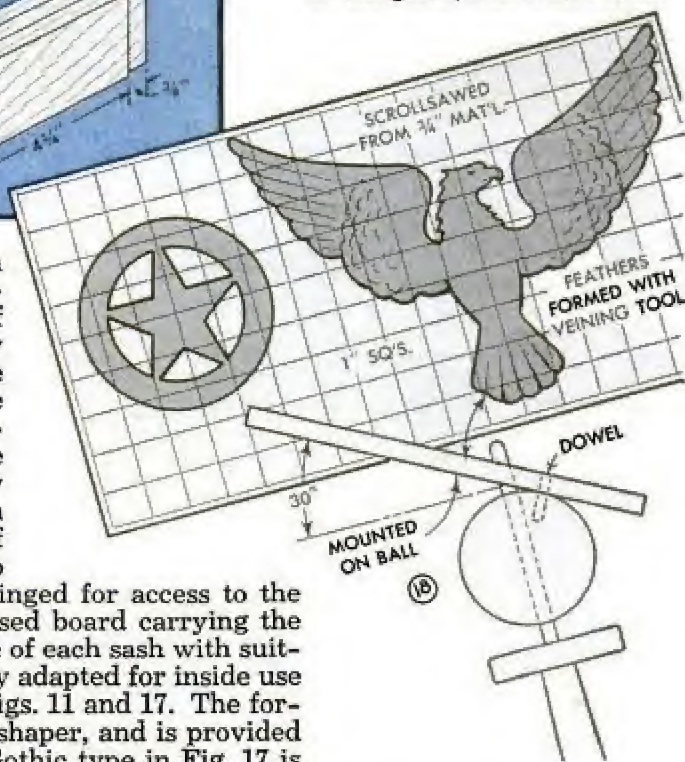


Smaller honor rolls are shown in Figs. 9 and 10. Fig. 9 shows a simple cabinet consisting of a frame of 2 by 4-in. stock. It has a stationary sash on one side and a hinged name panel on the other. Space below the cabinet is latticed to support a suitable flowering vine. The kiosk type of cabinet, Fig. 10, requires slightly more space than the flagpole on which it is mounted. It consists of six sashes having beveled edges to fit snugly together. One sash is hinged for access to the inside where a panel of hard-pressed board carrying the name cards is fastened to the inside of each sash with suitable wood or metal clips. Especially adapted for inside use are the two honor rolls shown in Figs. 11 and 17. The former has a molded frame, cut on a shaper, and is provided with an emblem at the top. The Gothic type in Fig. 17 is

particularly well suited for use in churches.

In case you are able to get a spruce timber 12 ft. long and 4 in. square, an excellent flagstaff is made as in Fig. 13. With a chalkline the taper is first marked on a side, from 4 in. at one end to 1 1/2 in. at the other. After sawing along these marks, the same procedure is followed to cut the two remaining tapers, which results in a square, tapered pole. With a drawshave it is trimmed to octagonal shape after which a plane is used to dress it round. Sandpapering is necessary before finishing.

Where only short lengths of board are available, a square, hollow staff can be made by installing bulkheads under the joints, Fig. 14. However, there should be only one joint on a side at each bulkhead, and the latter should be spaced 24 in. apart. Methods of splicing round stock are shown in Fig. 12. Hardwood cleats are standard equipment on all flagpoles for securing the halyard. Sheaves or pulleys are best to carry the halyard at the peak, but if not avail-



able, two eyes in a wooden collar will do, in which case the edges of the holes must be rounded and sanded smooth to avoid chafing the rope.

Two installations that permit the staff to be taken down are shown in Fig. 15. For a round pole, sink a 3-ft. length of 4-in. pipe in the ground and set the end of the pole in it, anchored with a bolt and provided with a wooden collar to keep out rain. A concrete footing may be added for additional reinforcement. A hollow square staff of the kind shown in Fig. 14, can be lifted off the core if the latter is set in concrete, by simply removing the screws, if the core itself does not come out easily due to swelling of the wood. In cold climates it is not generally recommended to set wooden posts in concrete bases because freezing causes moist wood to swell which sometimes results in breaking the concrete base if this is relatively small in size.

As brass or bronze castings for eagles are not available, an effective wooden job can be substituted by cutting the silhouette shown in Fig. 18 with a scroll saw, and adding the feather outlines with a veining tool. When mounted at a 30-degree angle on a ball at the top of a staff, the bird is not easy to distinguish from one of three dimensions. If you are experienced in wood carving you may prefer the built-up eagle shown in Fig. 16. The wings, tail and legs are carved separately and fastened to the body with dowels and waterproof glue. Claws are formed directly on the ball. A much simpler ornament for the top of a staff is the star and ring shown in the left-hand detail of Fig. 18. The ornament is scroll-sawed from hardwood.

Holder for Cutting Sandwiches Made From Pancake Turner



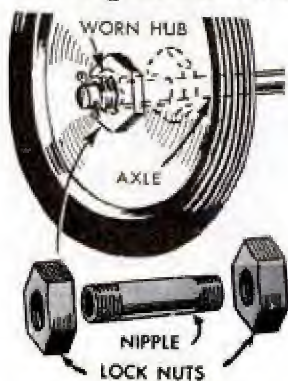
The split base of an ordinary pancake turner soldered to a wire handle formed as shown provides a unit which will permit cutting and serving a sandwich without touching the food with the hands. The sandwich is pressed down with the flat section of the unit, and the knife is then run through the split. When cut, the sandwich is scooped up and placed on the plate.

Edible Packing for Packages Sent to Servicemen

Peanuts, popcorn and similar edible items will provide suitable packing for boxes sent to servicemen stationed in the country, and at the same time they make good use of space otherwise wasted. Such filler packing keeps articles in boxes from rattling or breaking.



Hub on Disk-Type Coaster Wheel Repaired With Pipe Nipple

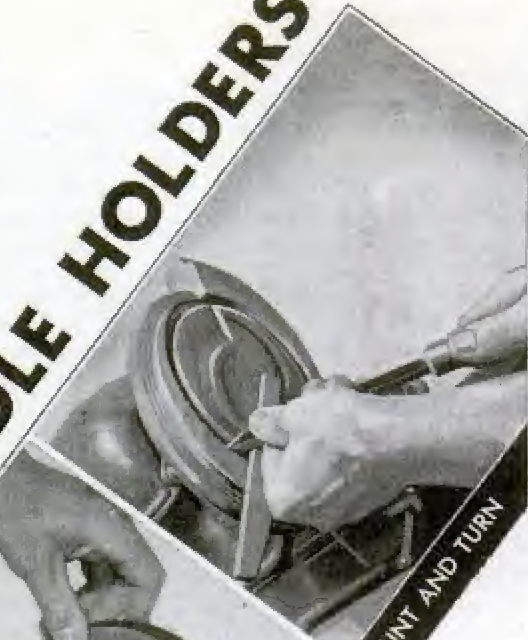
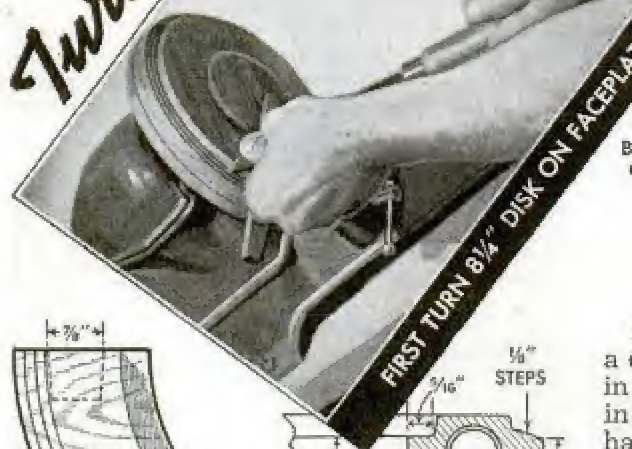


Disk-type wheels on coaster wagons that wear so badly in the hubs that they are useless, often can be repaired with a pipe nipple and a couple of lock nuts. Select a nipple of a size to make a good rotating fit on the axle and insert it

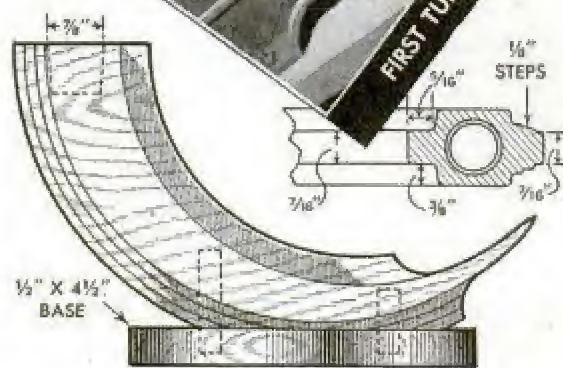
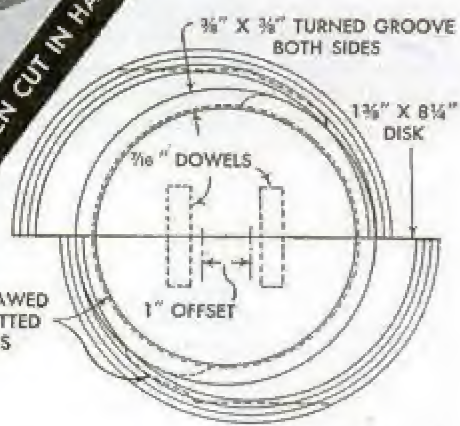
through the worn hole in the hub. Center it accurately and then hold it in place with a lock nut on each side. If the hole in the hub is large enough to let the nuts slip through, use large sheet-metal washers behind them.



Turn these Graceful CANDLE HOLDERS



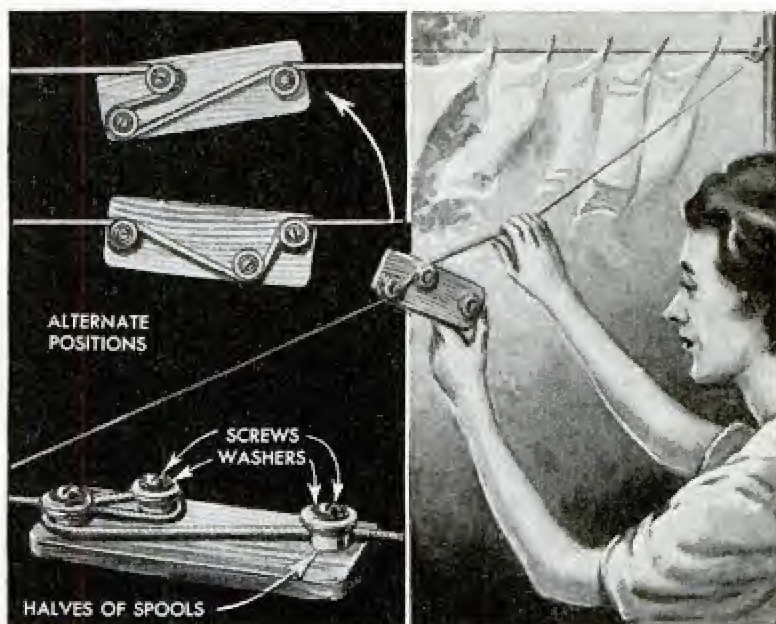
FIRST TURN $8\frac{1}{4}$ " DISK ON FACEPLATE — THEN CUT IN HALF AND DOWEL OFFSET — REMOUNT AND TURN



After turning a $13\frac{1}{8}$ by $8\frac{1}{4}$ -in. disk, turn a duplicate pattern on both sides as shown in the photos and the cross-sectional view in the lower detail. Then, saw the disk in half and reassemble it with dowels, offsetting the halves 1 in. Remount the disk and turn a groove in both sides as in the upper photo, and band-saw it as indicated by the dotted lines in the right, center detail. Complete the holders by drilling candle sockets in the upper ends and then doweeling them to circular bases as indicated in the lower detail.

Handy Tightener to Take Up Slack in Clothesline

This simple tightener can be made quickly by bolting three halves of empty thread spools in a staggered position on a piece of plywood or other thin block of wood. One way of using the tightener is to place the line between the two spools that are spaced closest together, after which the upper end of the block is pulled down so that the third spool can be hooked under the line, thus taking up the slack as shown in the upper detail. The lower two details show other methods of using the tightener, the one in the center taking up the least amount of slack in the line, while the one at the bottom gives the greatest tightening effect. Of course, the spacing of the spools is another factor



that controls the extent of tightening the line, and they can be spaced to suit.

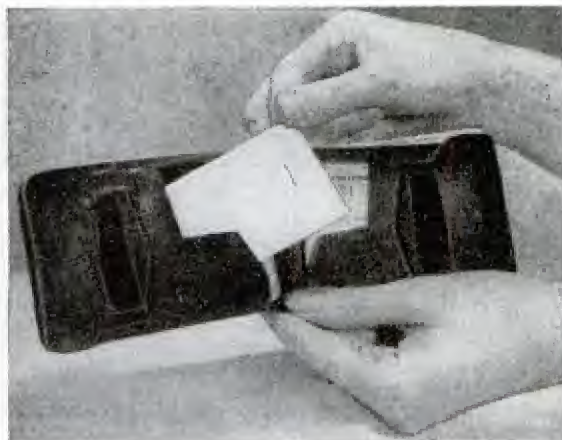
—Royce M. Roath, Earlville, Ill.

Solder and Flux Are Always Kept Together in This "Kit"

In order to keep his soldering accessories together in a handy kit, one man soldered together a reel of acid-core solder, one of rosin-core solder and a can of flux. In this way he did not have to waste time looking for various accessories in the shop, and there is no likelihood of forgetting to take a particular kind of solder or flux along on a job where it might be the one needed most. Of course, the number of reels of solder and cans of flux need not be limited to three as shown in the photo, but if desired, still more units can be added in the same manner.



Emergency Set of Car Keys Is Carried Conveniently in Your Wallet

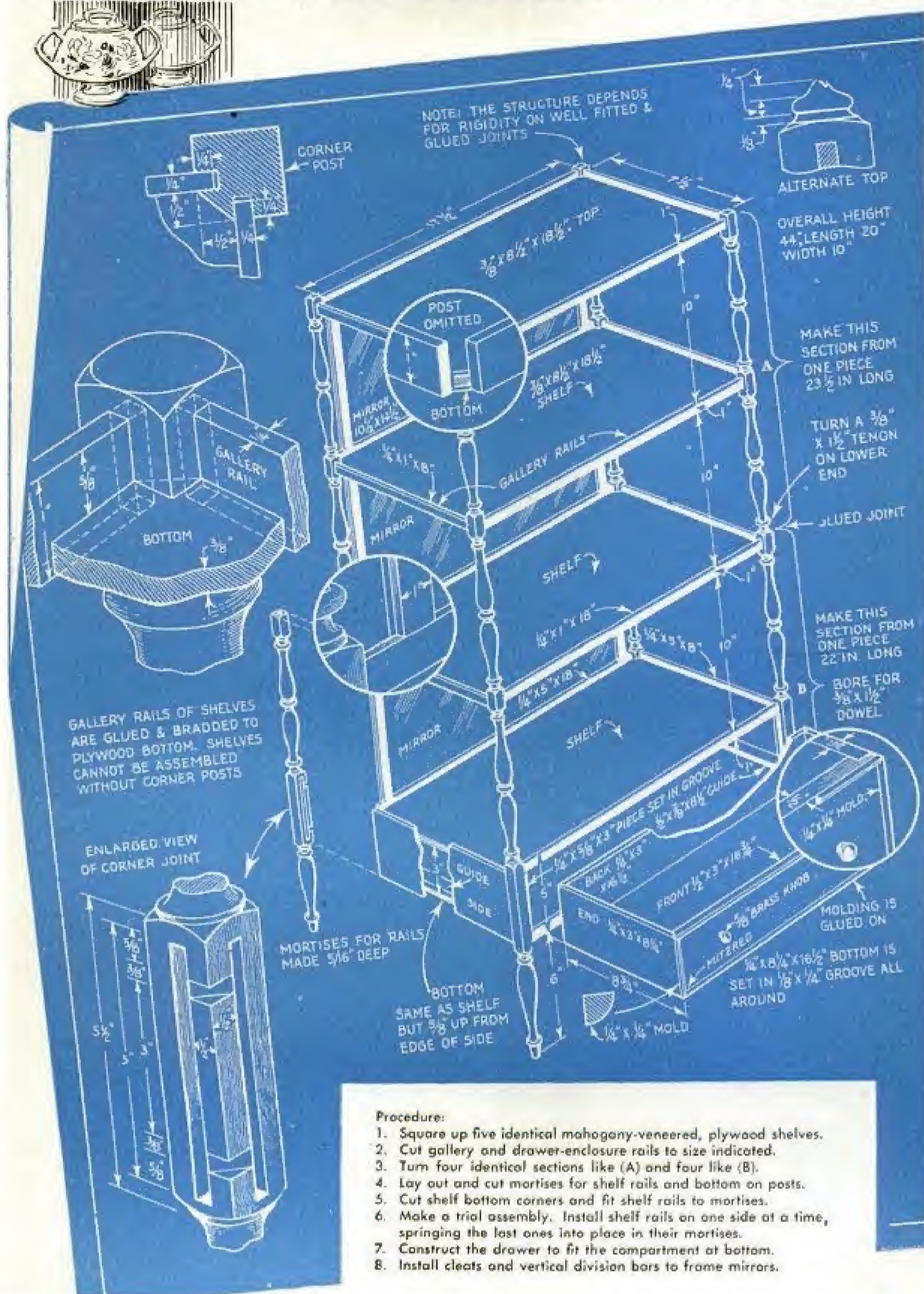


Instead of keeping an extra set of keys hidden somewhere on the car for emergency use in case the regular set is lost or locked inside the car, I find it more convenient to carry them in my wallet. I staple them between two business cards, although any fairly stiff cards will do. A folded postcard is ideal for the purpose.

—Roland Swedlund, Buffalo, N. Y.

❏ To straighten used baling wire, a headless nail is driven into a sturdy post. When the eye of the baling wire has been looped over the nail, the other end is jerked quickly with a pair of heavy pliers, and the wire is ready to be used again.

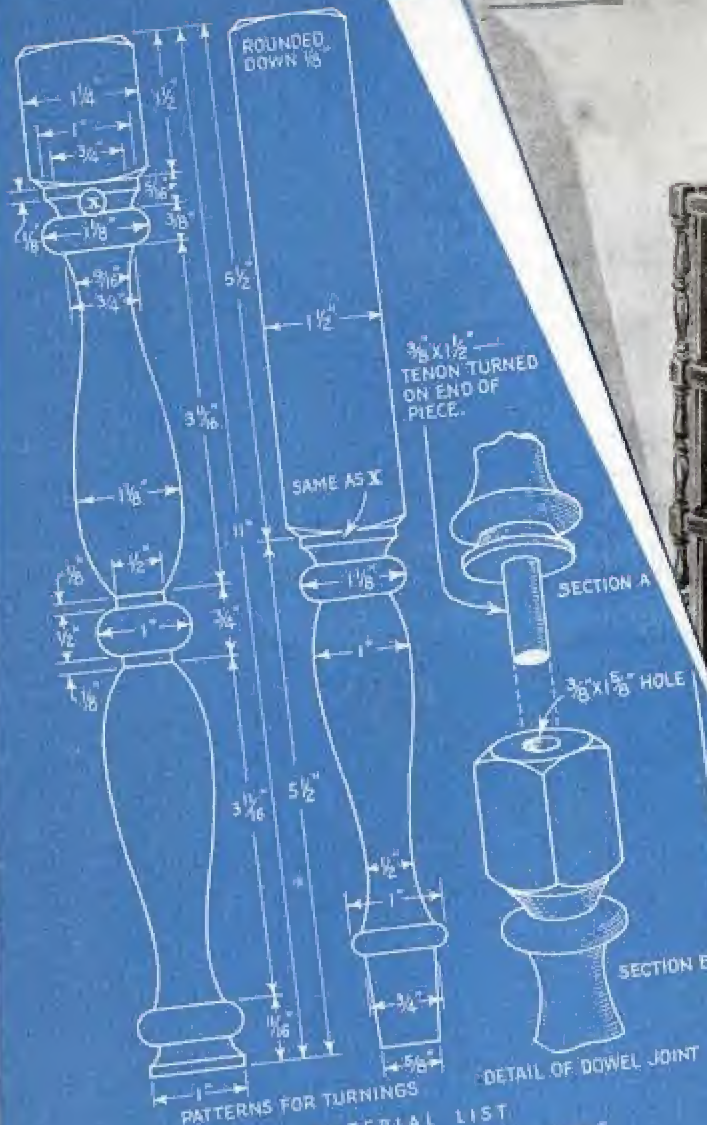
MIRROR-BACKED STAND



Procedure:

1. Square up five identical mahogany-veneered, plywood shelves.
2. Cut gallery and drawer-enclosure rails to size indicated.
3. Turn four identical sections like (A) and four like (B).
4. Lay out and cut mortises for shelf rails and bottom on posts.
5. Cut shelf bottom corners and fit shelf rails to mortises.
6. Make a trial assembly. Install shelf rails on one side at a time, springing the last ones into place in their mortises.
7. Construct the drawer to fit the compartment at bottom.
8. Install cleats and vertical division bars to frame mirrors.

for Your RARE CHINA

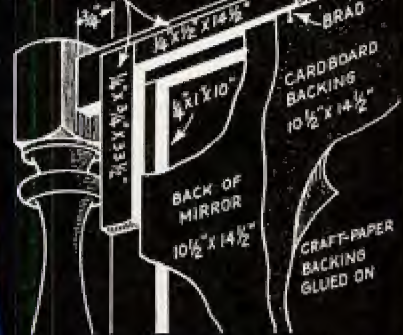


MATERIAL LIST

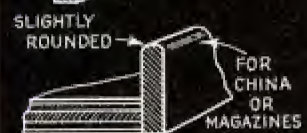
- 8 pcs. 1 3/8 x 1 3/4 x 25 in. maple—Corner posts
 - 5 pcs. 3/4 x 8 1/2 x 18 1/2 in. mahogany—Shelves
 - 9 pcs. 3/4 x 1 x 18 in. maple—Gallery sides
 - 2 pcs. 1/4 x 5 x 8 in. maple—Enclosure ends
 - 1 pc. 1/4 x 3 x 8 in. maple—Enclosure back
 - 4 pcs. 1/4 x 1/2 x 14 1/2 in. pine—Mirror cleats
 - 6 pcs. 1/4 x 1 x 10 in. maple—Mirror frame
 - 2 pcs. 1/4 x 3/4 x 33 1/2 in. pine—Mirror cleats
 - 1 pc. 1/2 x 3 x 16 1/4 in. maple—Drawer front
 - 2 pcs. 1/4 x 3 x 8 1/4 in. pine—Drawer sides
 - 1 pc. 1/4 x 3 x 16 1/2 in. pine—Drawer back
 - 1 pc. 1/4 x 3 x 16 1/2 in. plywood—Drawer bottom
 - 1 pc. 1/4 x 8 1/4 x 16 1/2 in. pine—Drawer guides
 - 2 pcs. 1/4 x 3/4 x 8 1/2 in. maple—Vertical strips
 - 4 lin. ft. 1/4 x 1/4 in.—Mold for drawer front
- * Allowance made for turning or mitering



CLEATS GLUED & NAILED

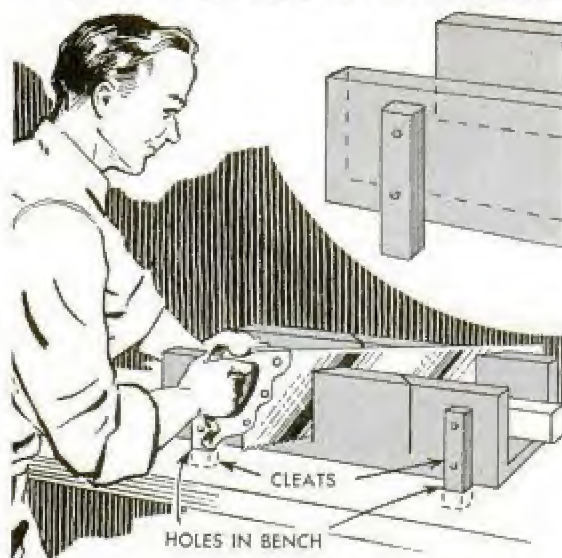


DETAIL OF MIRROR FRAMING FROM REAR



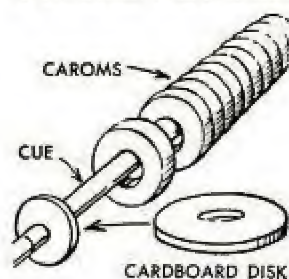
NOTE: DESIGN MAY BE CONVERTED FOR USE AS BOOKCASE BY SETTING SHELVES FLUSH WITH TOP OF GALLERY RAILS

Miter Box Held Securely in Place By Cleats to Fit Holes in Bench



After experiencing difficulty in holding his homemade miter box securely while using it, one craftsman nailed cleats to the side of the box so that they projected to fit into holes drilled into his bench top. If desired, the projecting ends of the cleats can be rounded to a small diameter to reduce the size of the holes in the bench.

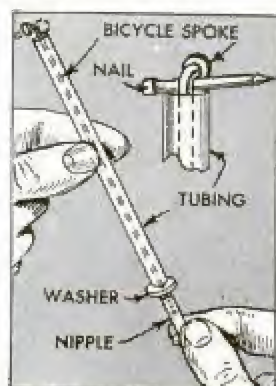
Caroms Are Stored on Cue Stick



The annoyance of finding a number of caroms missing when the board is brought from the store-room for a game, may be avoided by keeping the caroms on one of the cue sticks. A cardboard disk slipped over the small end of the cue keeps the caroms from sliding off.

This Holder Starts Small Nails In Hard-to-Reach Places

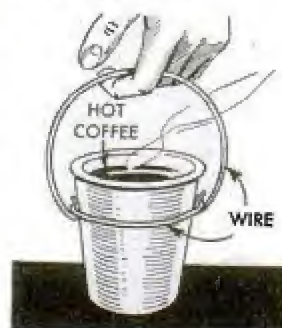
Starting a nail in a place that is hard to reach is no problem with this holder, which grips the nail firmly until released. The holder consists of a bicycle spoke inserted into a piece of small tubing, the tubing being of a length that will al-



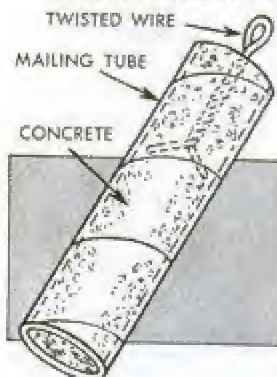
low the nail to be pulled up tightly under the bent end of the spoke when the nipple is turned up against the tube at the other end.—C. G. Cutting, Brightwaters, N. Y.

No 'Hot Finger' From Paper Cups Carried in Wire Holder

The problem of carrying paper cups of hot coffee from the cafeteria without burning their hands was solved by employees of an eastern war plant who formed holders of wire for the purpose. A large loop was made to fit underneath the rim of the cup and another loop attached to serve as a handle, as illustrated.—Kenneth Murray, Baltimore, Md.



Concrete Sash Weights Substitute For Hard-to-Get Metal Ones

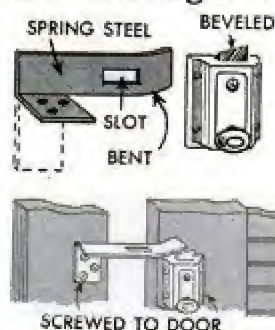


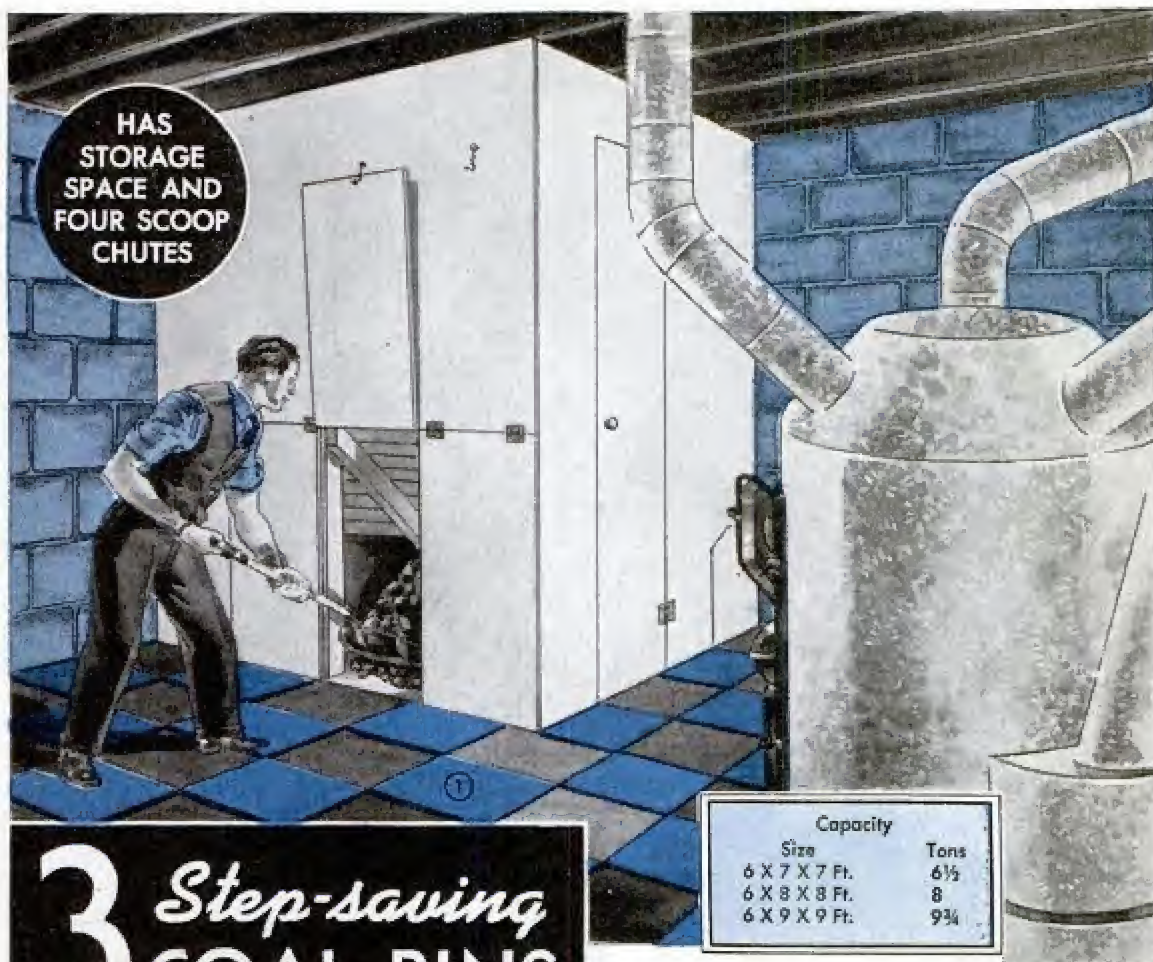
A carpenter who was unable to buy sash weights due to the shortage of metal, made some by filling lengths of mailing tube with concrete. Twisted wire to serve as eyes for attaching the cords, were embedded in the wet concrete. Weights

for closing gates can be made in a similar manner by filling cans with concrete.

Night Latch Used on Sliding Door

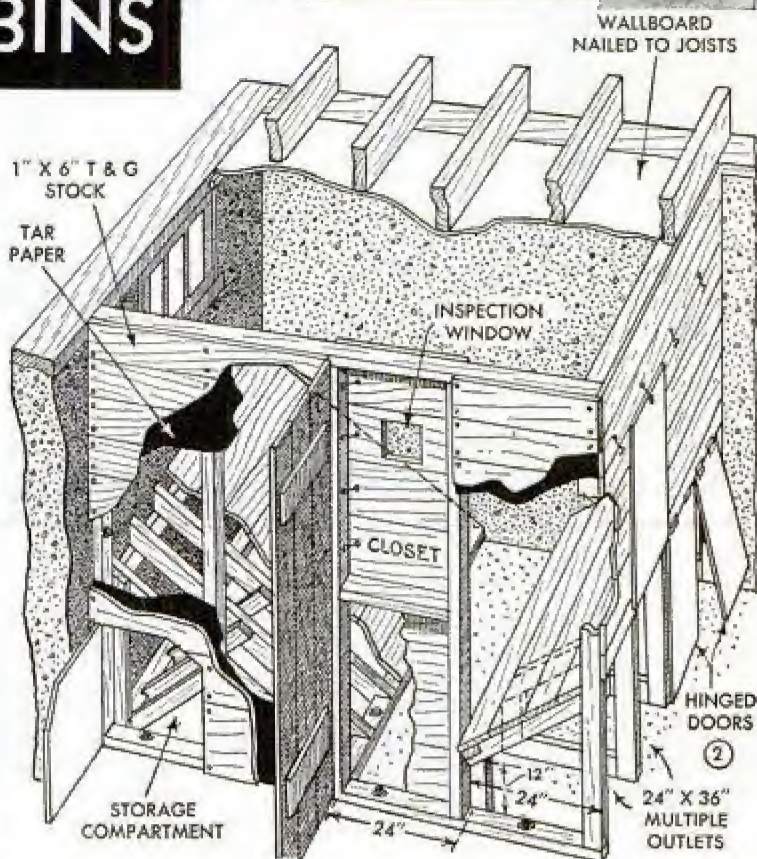
Desiring to use a night lock on the sliding doors of his garage, one man fixed up the lock by making a striker plate of the shape shown. Then, by mounting the latch in a vertical position on the edge of one door, and screwing the plate to the edge of the other door, the latch bolt would easily slide into the slotted striker plate. It will be necessary, of course, to bevel the latch bolt as indicated, so that it will slide under the latch plate.

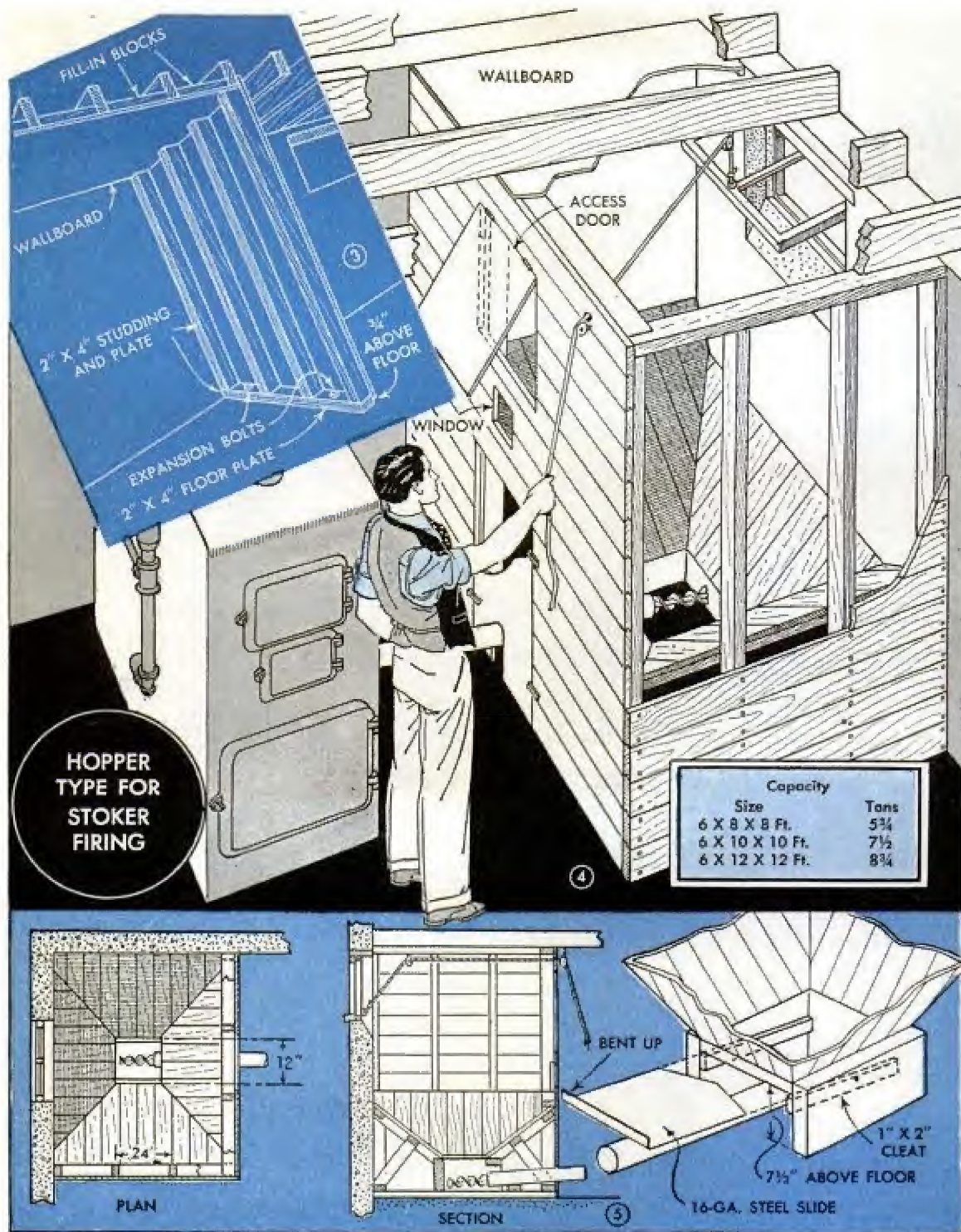




3 Step-saving COAL BINS

IT TAKES no more skill to build a neat, long-lasting coal bin that is planned for convenience than it does to nail up two or three walls merely to retain fuel in one corner of your basement. A well planned bin should be as close as possible to the heating plant and yet be easily accessible for fuel delivery. It should be as nearly dust-tight as possible to help keep the basement clean. Also, if possible, it should be large enough to hold a season's fuel supply, thus making frequent deliveries unnecessary. Size of the bin will depend on the amount of fuel required. The bins shown here were designed by Anthracite Industries Incorporated, and the capacity tables are for anthracite coal. Similar types of bins,





larger in size, can be used for soft coal. For estimating the size required, it is best to ask your dealer how many cubic feet there are in a ton of the coal you are using, and then build your bin accordingly. When planning it, allow for a clearance of $1\frac{1}{2}$ to 2 ft. between the fuel and the ceiling. It is hard work to shovel the coal up against the ceiling, and some dealers won't do it.

Well seasoned tongue-and-groove lumber, waterproof plywood (the plies of reg-

ular plywood may separate in a damp basement), and masonry (concrete or cinder blocks) are the materials most used for coal bins. The type of bin bottom, flat or sloped, is a matter of choice. A sloped bottom is practically a necessity for a bin-type stoker, and has the advantage of feeding the coal to the scoop chute when hand firing.

The bin pictured in Fig. 1 and detailed in Fig. 2 has the bottom sloped on two sides, and has four scoop chutes along the front,

each being covered with a hinged door. Also, space under the other slope is utilized for storage, and a door to enter the bin is provided. Boards hinged to the inner edge of the door frame retain the fuel and the space between the boards and door provides a closet to hold firing tools. The ceiling is made dust-tight with wallboard nailed to the joists as in Fig. 3, and all framing is of 2 by 4-in. stock. Floor plates are fastened with expansion bolts as are the studs that join the basement walls.

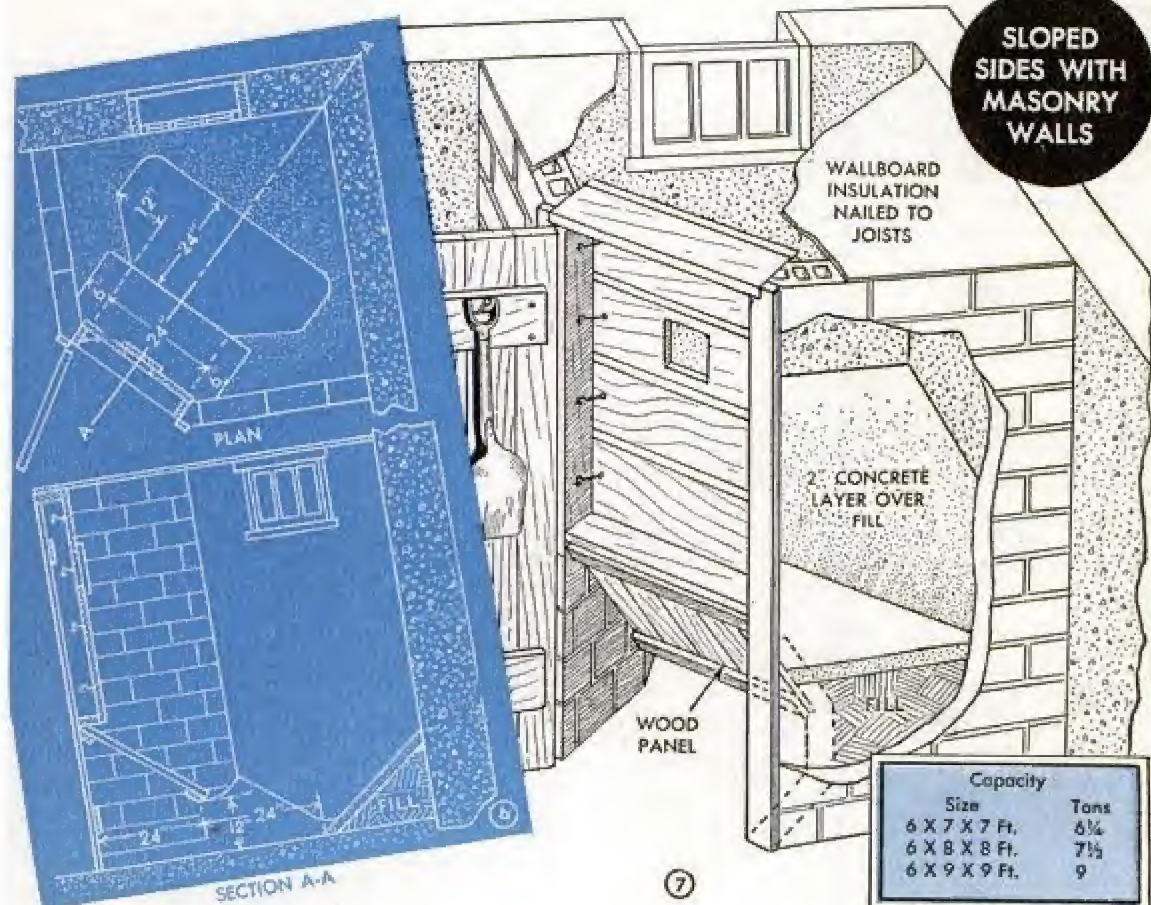
The hopper-type bin for stoker firing in Fig. 4 is of similar construction except that scoop chutes are eliminated. The bottom is sloped from all four sides to a small box containing the stoker conveyor. The box is detailed in Fig. 5 and is about 7½ by 16 in. in size. A steel slide is used to close the hopper when the stoker conveyor needs attention. A small access window can be operated from outside the bin.

Although more expensive, the neat masonry bin shown in Fig. 7 has the advantage of being the most nearly dust-tight, and it will not deteriorate in a damp basement. The bottom slopes four ways toward the scoop chute, which is at the forward corner. The sloped portions are covered with



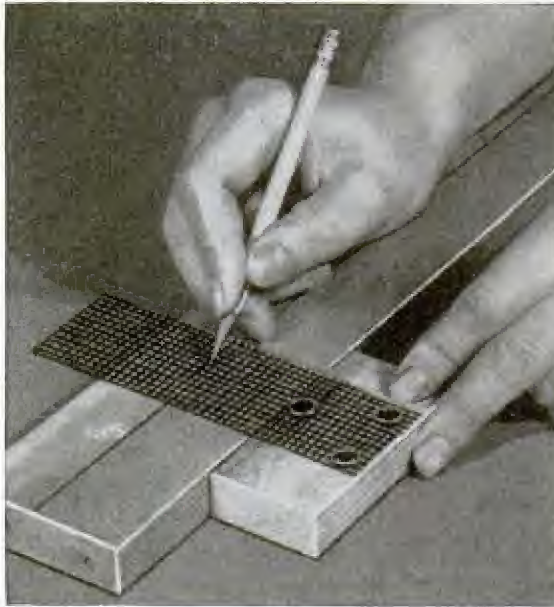
a 2-in. layer of concrete poured over a fill of earth or ashes well compacted.

Notice in Fig. 7 that the sides of the scoop chute are of the same material as the walls and are sloped at the same angle as the bottom. A wooden panel made up from short boards covers the sloped top of the chute as indicated.



Capacity		
Size	Tons	
6 X 7 X 7 Ft.	8¼	
6 X 8 X 8 Ft.	7½	
6 X 9 X 9 Ft.	9	

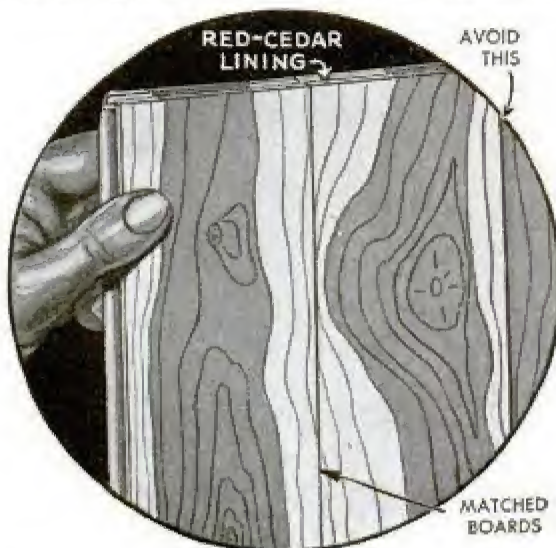
Emergency Marking Gage Made From Screen Wire and Block



When a marking gage is not available, one may be improvised by tacking a scrap of screen wire onto a block at right angles. By placing the block against the board to be marked, with the screen on top, inserting a pencil point in the mesh to give the proper width and moving both gage and pencil down the board, a fairly accurate marking can be obtained.

Proper Matching of Red Cedar Brings Out Its Beauty

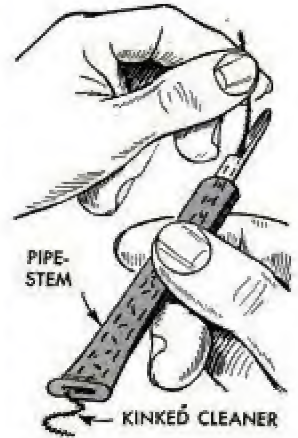
To bring out the attractive grain of red cedar closet lining, match the boards in a systematic manner instead of simply joining them at random. Do this by selecting a series of boards in which the veins of white appear as flowing units when the



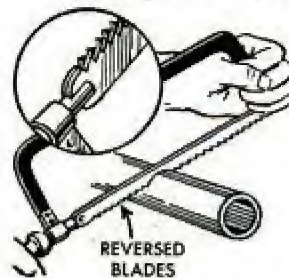
boards are joined. Avoid the severe straight line which is formed when a strip of white and a strip of red are joined together along the cut.

Easy Way to Clean Pipe Stem Having a Wide Hole

A pipe stem which has a wide, tapering hole can be cleaned easily with one insertion of the cleaner by kinking the latter as indicated. The kinks cause the cleaner to contact both sides of the hole at its widest part; then they straighten out as the cleaner is pulled through the narrower part.



Twin Hacksaw Blades Reversed To Cut Thin Tubing Easily



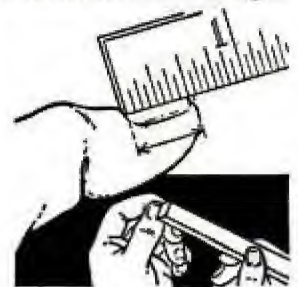
If you experience difficulty by having the teeth of a hacksaw blade catch and break off when cutting thin tubing, use two blades and put them in the saw frame so that the teeth of one

face opposite the teeth of the other. This will keep the teeth of one blade from digging in, and will permit the blades to cut on both strokes.

—H. D. Chapman, Mt. Rainier, Md.

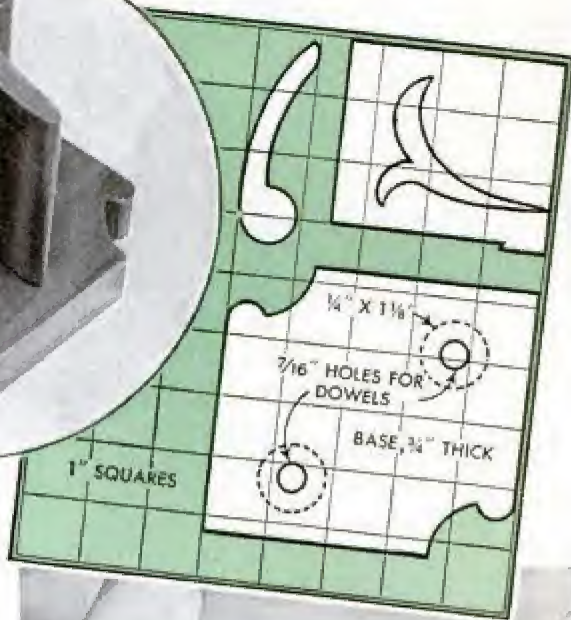
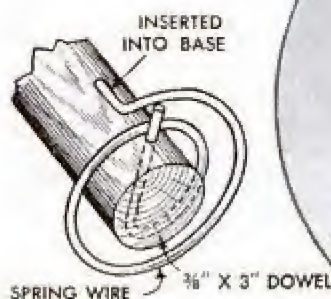
Thumb Used as Thickness Gage

The distance between the end of your thumb and the cuticle of the nail makes a fairly accurate, short-scale measure by which to gage the thickness of lumber and other building materials, and it is one that is always with you. Simply measure this distance on your thumb and memorize it. Trimming the thumb nail does not, of course, alter the measurement.



—J. Modroch, Danbury, Conn.

Holder Adjusts Itself to One or Several Letters

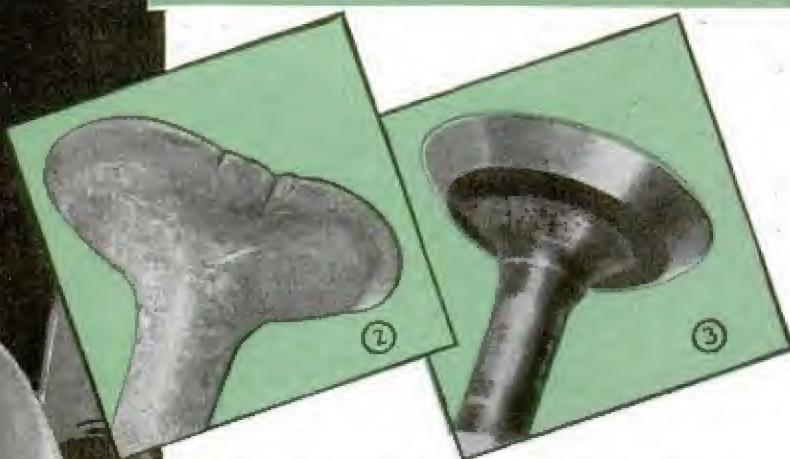


Besides being an attractive desk ornament, this letter holder will retain one letter just as firmly and neatly as it will several of them. This is because the sides or wings are pivoted and are under tension of springs, which keep them pressed firmly against the letters at all times. The holder looks best in walnut or maple, or a combination of the two, as for instance a walnut base and maple jaws. After jigsawing the base and wings to the size and shape indicated in the center right-hand detail, drill them to receive hardwood dowels as indicated in the upper left-hand photo. Before inserting the dowels, however, attach a spring to each one as indicated in the lower left-hand detail. The free end of each spring is slipped into a small hole drilled in the recessed portion of the base to keep it from turning. The wings must be attached firmly to the dowels which is best done with glue or small wooden pins, preferably the latter as the pins will permit dismantling a wing should a spring have to be replaced. If suitable springs are not available, you can make them easily from spring



wire. Three coats of shellac well rubbed down between coats produces a nice finish on the holder. It is a good idea to glue a piece of thin felt or blotting paper to the bottom of the base to avoid scratching highly polished desk tops.

KEEP YOUR



Left, valve burned because of insufficient tappet clearance. Right, refaced valve unfit for service because of thin, feather edge around the head

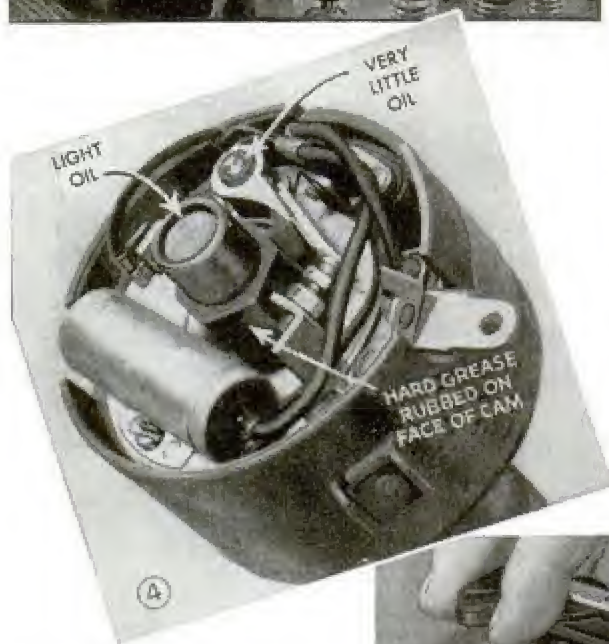
By C. E. Packer

THE DIFFERENCE between a car that needs constant repairs and one that rolls along trouble-free month after month often lies in the way they are driven and the way in which little things are taken care of before they develop into major troubles. The burned and warped valve in Fig. 2 is a good example of what happens when such a little thing as adjusting the tappets, Fig. 1, is neglected. This condition is caused by insufficient tappet clearance.

Engines are designed with definite clearance between the valve lifter and the valve stem to provide for expansion. When this clearance is reduced the valve is held open too long and, in the case of exhaust valves, burning is likely because the valve does not remain on its seat long enough to transfer the heat to the water jacket. When valves are not burned quite so badly as the one shown, attempts to restore them often are made

by refacing them like the one in Fig. 3. Such a valve may hold compression and appear to operate satisfactorily, but can be the direct cause of serious pinging on a hard pull due to the knifelike edge of the valve head, which becomes incandescent and causes the fuel charge to ignite before the spark occurs in the cylinder.

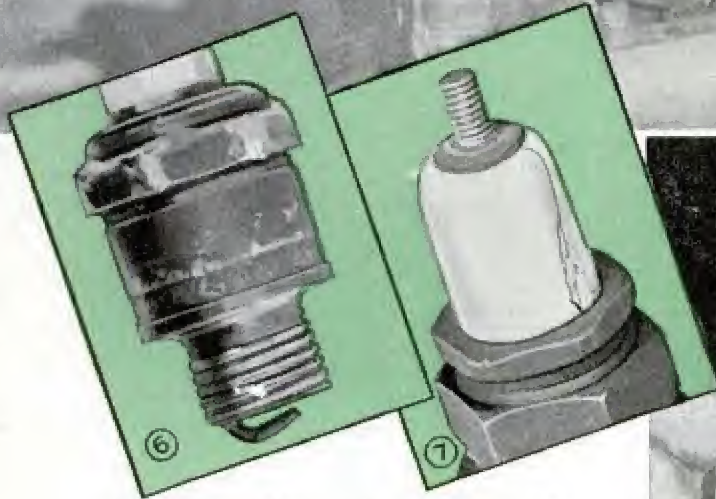
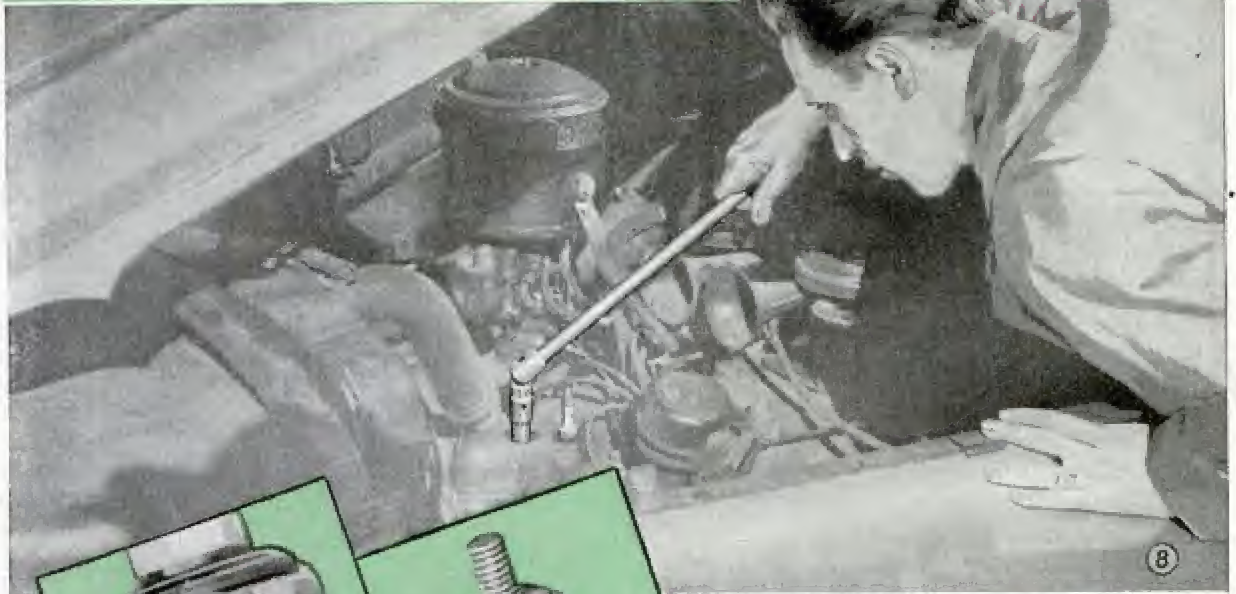
The ignition distribu-



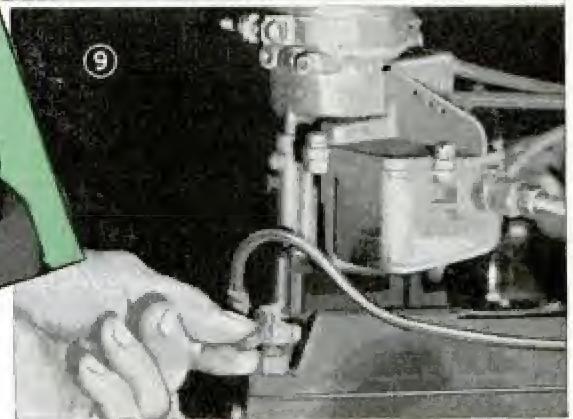
In addition to regular lubrication of the distributor, apply oil to the cam wick and the pivoted point, and hard grease to the cam face. Check the automatic spark control by turning the rotor first one way and then the other to see that it swings back to position freely



CAR ROLLING



Spark plug at left was damaged by use of too large a wrench, which slipped and cracked porcelain insulator at the right



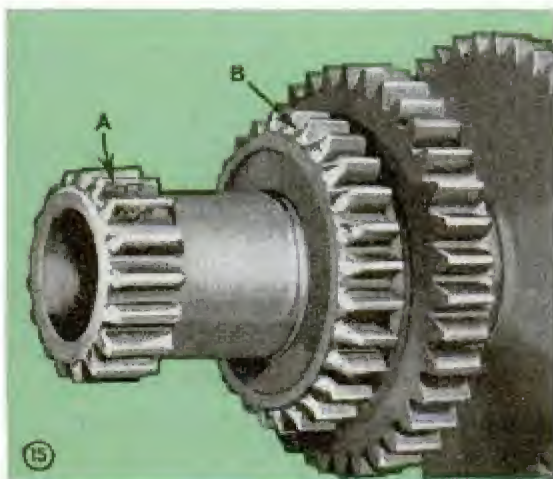
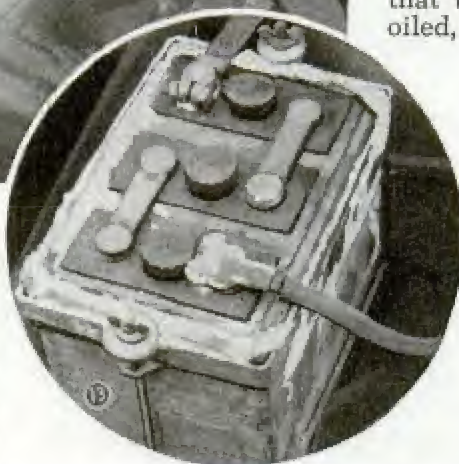
tor is another part often overlooked. In addition to the normal lubrication, it is important to keep the felt wick in the end of the breaker cam saturated with light oil. If this is not done, the cam may freeze to the shaft, making the automatic control inoperative. Increased life of the breaker points will result if a small amount of hard grease is applied to the cam, and a drop of oil is placed on the pivot of the moving point at thousand-mile intervals, Fig. 4. To check action of the automatic spark control, grip the rotor as in Fig. 5, gently twist it to one side and then release it. Any unusual stiffness or failure to return to its original position indicates faulty action which will



Bearing above was scored by foreign matter in diluted oil. Scored piston is result of gas washing oil from the surface of cylinder wall, allowing metal-to-metal contact



Condition of battery should be checked regularly with a hydrometer. Corroded battery at right indicates level of electrolyte is too high or charging rate is excessive, causing acid to overflow, thus reducing strength of electrolyte. Spring bolt below was worn and scored by lack of proper lubrication at regular intervals



reduce engine performance, interfere with satisfactory gas mileage, and may even be the indirect cause of breaking the starter drive.

Use of anything but a well fitting socket wrench on spark plugs, Fig. 8, is likely to damage the plug bases or insulators as in Figs. 6 and 7. Dirt and moisture accumulating in the cracked porcelain will rob the engine of its spark. Spark plugs and cylinder heads can be ruined by pulling up a plug too tightly. It must be tight but threads on the small plugs can be stripped easily. Proper installation consists of tightening a plug with the fingers after checking that the threads are clean and oiled, and then giving it one-half

turn with a wrench to squeeze it down against a good copper gasket. Plugs that are too tight will be thrown out of adjustment, and those that are too loose will burn up as a result of hot gases escaping past the threads.

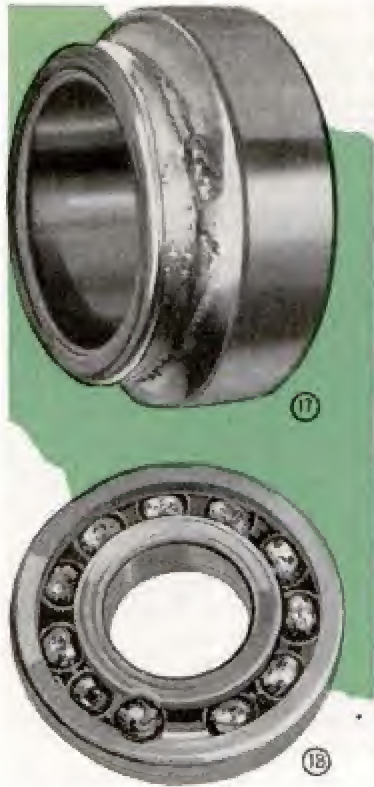
Finally, economical operation and smooth performance are obtained at lower speeds by careful carburetor adjustment. Most carburetors have a setting similar to the one

shown in Fig. 9. With the engine thoroughly warmed up and idling slowly, the setting is turned to the left until the engine begins to "lope" and "roll" noticeably. Then it is turned to the right very slowly until the engine smooths out and begins to lose speed, after which the adjustment is turned to the left again until the engine just begins to pick up speed.

Perhaps the greatest problem of present-day operation comes from running a car with the motor relatively "cold" due to frequent starts, slow speed, and reduced mileage. The result is that raw gasoline works down past the pistons into the crankcase, washes oil from polished surfaces, and invites destructive pitting. The gasoline also washes down abrasive metal particles, road dirt, and carbon which scratch bearing surfaces as in Fig. 10, and contribute to the scratching and scoring of pistons as shown in Fig. 11.

Infrequent lubrication of the chassis causes shackle bolts to wear like the one in Fig. 14. This in turn permits annoying

Chipped teeth of transmission gear at A are caused by improper lubrication, and worn teeth at B are caused by the gear spinning while shifting gears



Cone and bearing at left show what happens when bearings are not adjusted and lubricated correctly

rattles and "chassis shake," which is injurious to tires and other parts. Often, failure to change to seasonal lubrication causes gear failure. The teeth of the transmission gear in Fig. 15 illustrate what takes place. Here the faces of the teeth of the gear (A) are deeply pitted and chipped, due to high pressures that cut through the lubricant. Continued whirling of this gear when shifting the transmission caused the worn condition of the teeth of gear (B).

Frequently, wheel bearings, Fig. 16, are neglected until the races are seriously damaged as shown by the cone in Fig. 17 which has been cut by broken balls of the bearing in Fig. 18. Unfortunately, when an owner discovers this damage he frequently overdoes the lubricating job and may completely "blow out" the grease seal in the rear-axle housing, which allows lubricant to work into the brakes. Grease in a brake has two opposite effects. When

first applied, the brake fails to hold, but as it heats up it "grabs," causing tire wear.

Being the very heart of the car, the electrical system should be checked regularly. When a battery is corroded like the one in Fig. 13, it may be that the water level is being carried too high in the cells, or that the charging rate is too high. When water is added, the level should never be brought more than $\frac{3}{8}$ in. above the plates. This will allow for expansion of the electrolyte when charging. It is best to check the battery at regular intervals with a hydrometer, as in Fig. 12. Keeping the specific gravity reading between 1.225 and 1.300 assures maximum battery life. If, however, the battery is constantly at the higher reading, perhaps the generator charging rate can be reduced. An excessive charging rate drives off the electrolyte and causes rapid wear and heating of the generator.

Saving Your Anti-Freeze Solution for Use Next Winter

Removing the anti-freeze solution from your car and storing it for use next winter assures you of some protection in case you are unable to obtain the required amount of new solution. Solutions that can be stored are those containing ethylene glycol (permanent anti-freeze solutions,) and those containing denatured ethyl alcohol, or ethanol, and methanol (wood alcohol.) Clean glass jugs or cans provide suitable containers. If cans are used, precautions

should be taken to prevent rusting, and the containers should be labeled and marked poison. Before the solution is used again, its strength should be checked, and it should be tested for acid content with blue litmus paper or similar indicator. If blue litmus paper turns red when immersed in the solution, an ounce or so of washing soda should be dissolved in the solution to neutralize the acid. Also, it is desirable to add a rust inhibitor.

Cutouts Made on Sewing Machine Using Altered Needle



Making cardboard cutouts on an ordinary foot-powered sewing machine is a fairly simple matter when the needle has been altered as shown. A heavy needle is cut to about 1 in. in length and the end ground to a sharp, chisel edge. When inserted, in the same manner as an ordinary needle, it should project far enough to penetrate about $\frac{1}{8}$ in. below the surface of the machine's table. With the design laid out on cardboard, proceed as if sewing along the lines. Soft cardboard up to about $\frac{1}{4}$ in. may be cut. Be careful in using heavier or tougher cardboard. Proceed slowly at first until sure the machine is cutting properly.

—Frank Shore, New York City

Moth Ball Usefulness Multiplied With "Pin-Up" Models



these pins on evergreen branches, moth balls discourage dogs. Pinned in this way, they also are

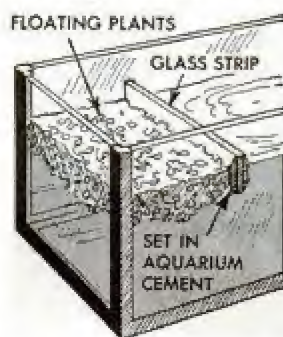
Moth balls can be put to many new uses if a pin, either straight or bent to form a hook, is heated and pushed into the moth ball to the center. After a few seconds cooling, the pin is permanently embedded. Hung by

much easier to place properly in clothing. They can be attached to portions of furniture which ordinarily would not be protected during storage, and are also handier in protecting collections kept in cases—in fact, wherever moth balls are used.

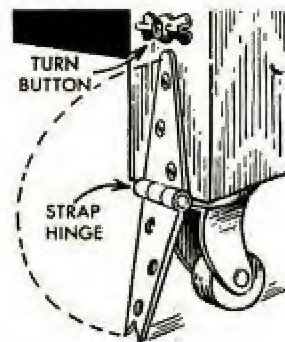
Glass Strip in Fish Aquarium Controls Floating Plants

To keep floating plants from covering the surface of your aquarium, and to provide a thick growth for concealing baby fish, wedge a strip of glass, 2 in. wide, across the width of the tank, with the top edge slightly above the water. An application of aquarium cement will make the installation permanent.

—S. P. Wiener, South Norwalk, Conn.



Hinge Stops on Castered Bench Prevent It From Moving About



should rest at the angle indicated, when dropped down to the floor, and can be notched at the ends to provide points to engage the floor. Turnbuttons hold the hinge ends when they are swung up out of the way to move the bench.

If you have a heavy workbench that is provided with casters, and it is difficult to keep the bench from moving away from the wall, attach strap hinges to the front legs to serve as stops. The free ends of the hinges

Lock Washers From Coil Spring

The next time you need some small lock washers and there are none at hand, just take a small coil spring and cut off a few of the coils, which will serve nicely as washers.

The coils are cut off easily by inserting a small rod into the spring and using this as an anvil under a chisel.

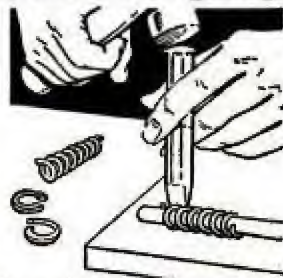
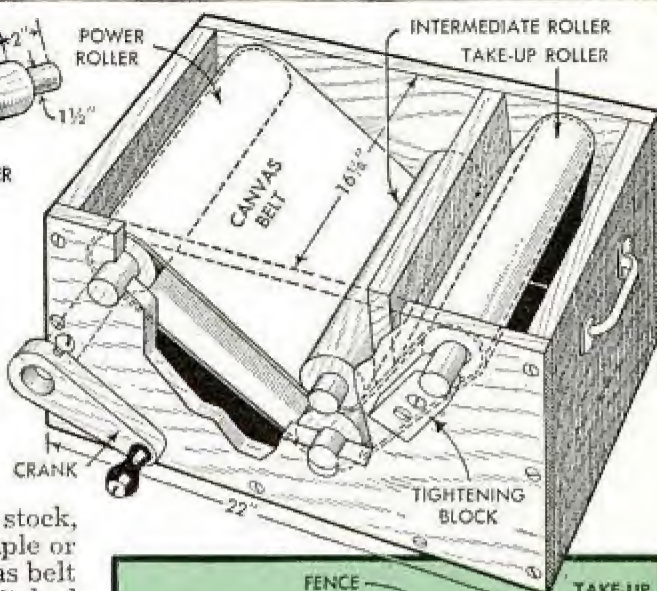
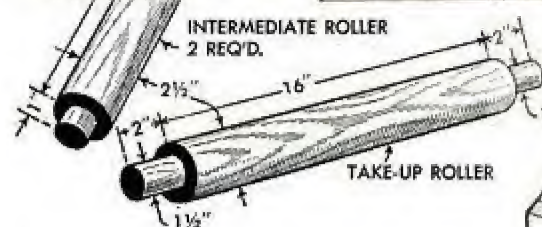
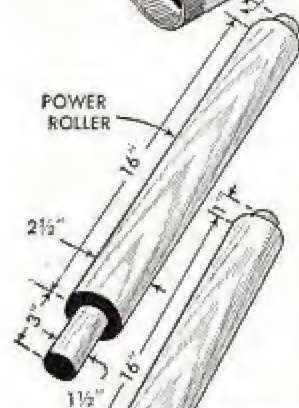
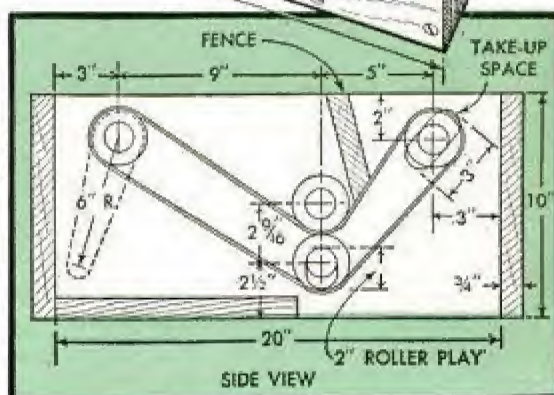


PHOTO-PRINT STRAIGHTENER



This inexpensive wood and canvas print straightener enables you to do a professional job on your photographs. The dimensions shown are for 8 by 10 in. or 11 by 14 in. prints. For smaller prints, the top intermediate roller should be smaller—about 1 1/4 in. in diameter for 4 by 5 in. prints. The outside housing, crank and fence are 1-in. stock, while the rollers are turned from maple or other close-grained wood. The canvas belt is cut diagonally and the seam is stitched down. As the canvas will stretch, tightening blocks, preferably having slots for adjustment, are installed to take up slack. Move the blocks up as far as possible so that the canvas is taut, then tighten the screws. If the canvas goes toward one side, lower the roller on that side. Some play must be left in the bearing ends of the lower intermediate roller. Prints to be straightened are inserted between the fence and the upper intermediate roller.

—Jack Mellinger, West Orange, N. J.



Using an Eraser on Photo Prints Reduces Local Shadows



Dark areas of prints often can be reduced to a lighter shade with the use of an ordinary pencil eraser. An ink eraser will do the work faster but requires more care since it is more abrasive. The method is especially suitable for smaller areas and is adaptable to matte and semimatte papers. After the print has been reduced, a light coating of oil medium is applied over the entire surface to prevent visible marks.

Closeups With Ordinary Cameras Taken by Switching Lenses

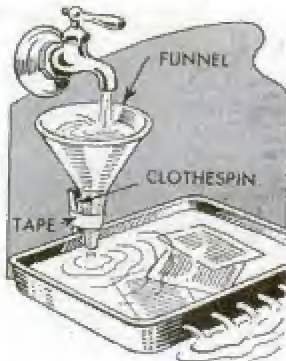
Closeup work can be taken without the use of an auxiliary lens with an ordinary No. 120 folding camera simply by changing the lens to a position in front of the shutter. This type of camera has a thread in front



of the shutter of exactly the same size as that in the rear, making it easy to switch the lens. With cameras in which both lenses are the same size, a similar technique can be applied. Shots can be taken as close as one foot. Proper distances are, of course, determined through the use of a ground glass.

Funnel Directs Water Properly While Washing Prints

You can direct the faucet water into your print-washing trays near the bottom to avoid damaging the photo papers by taping a clothespin to the spout of a funnel. This assembly, clamped to the tray under the faucet, will give your prints thorough and safe washing. It is best to arrange the funnel so that the end of the spout will be located just slightly above the tray bottom.



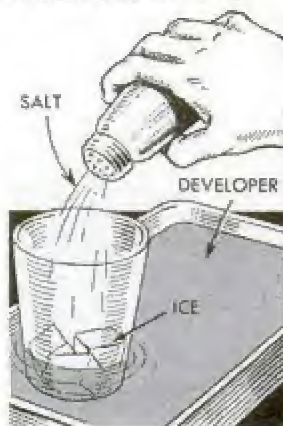
Clothespin Handle on Reflector



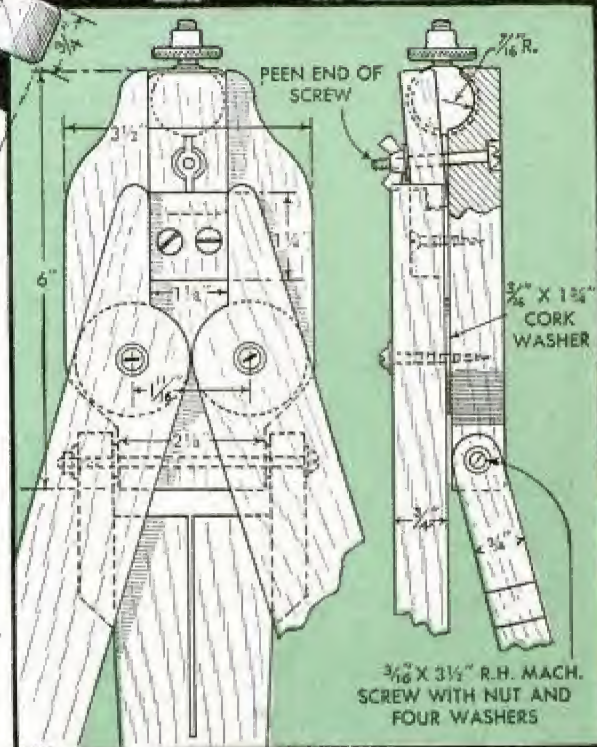
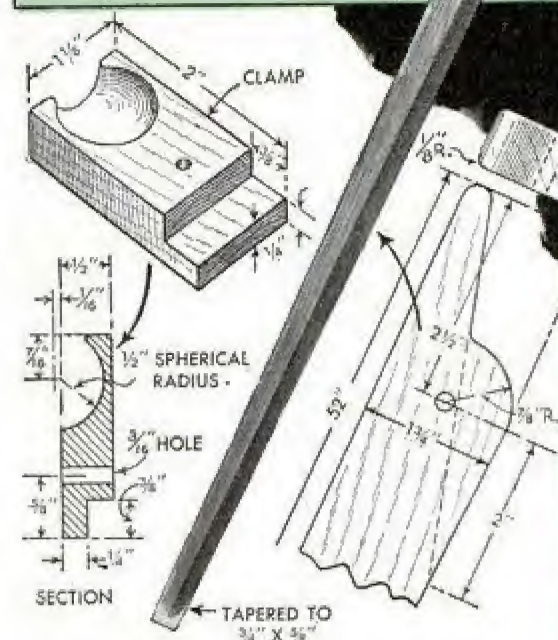
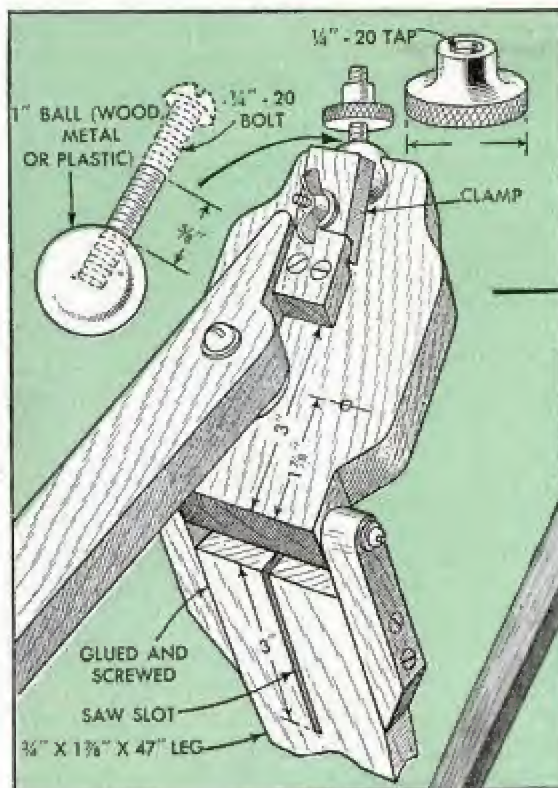
Clipped to the rim of a photo-flood reflector, a spring-type clothespin provides a convenient handle for adjusting it without the risk of burning the fingers or getting fingerprints on the polished surface of the reflector.

Developer Cooled More Quickly With Salt in Tumbler of Ice

During hot weather when you find it necessary to use ice in a tumbler to cool a tray of developer, you can save time by applying salt to the ice to make it melt more rapidly. This takes up the heat from the developing solution, causing it to cool more quickly.

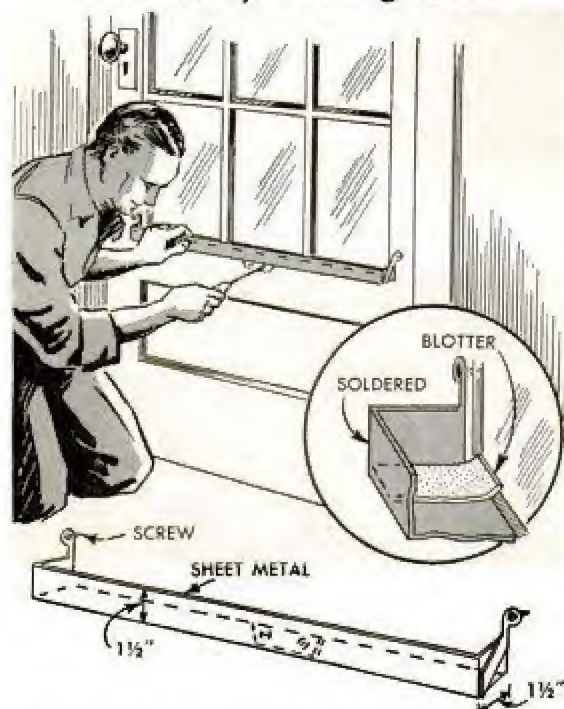


Swivel-head TRIPOD



Although the legs of this rigid, all-wood tripod do not telescope, it can be adjusted for height to some extent by spreading the legs. The swivel head makes it possible to tilt the camera in practically any position for still shots and, with the clamp loosened slightly, action can be followed with a movie camera. Make the tripod of hardwood such as birch or maple. Leg fastenings should be tightened sufficiently to provide friction

Pan on Window Checks Damage Caused by Melting Frost

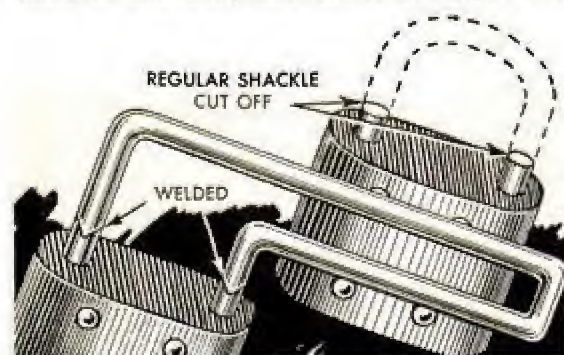


To check the water which melted from frosted door and window panes before it ran down and froze between the door and the tread or caused other damage, one man cut and bent a metal strip into a pan, soldered the joints and screwed it to the door just beneath the panes. Blotters to make a thickness of about $\frac{1}{2}$ in. are placed in the pan to absorb the moisture as it runs down. Similar pans may be attached to other doors and windows which cause the same trouble.

—Henry J. DeFreeuw, South Bend, Ind.

Altering Shackles on Padlocks To Suit Special Purposes

It's not difficult to alter the shape of a padlock shackle to suit some unusual locking job, such as locking oars to the side of a boat, a telephone receiver to its hook, etc. All you have to do is cut off the shackle close to the lock, and either reshape it to

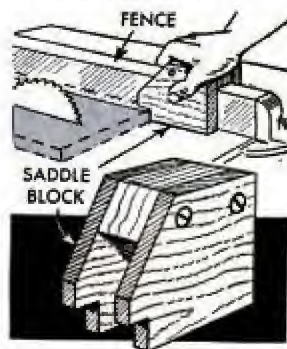


suit or else make a new shackle from small-diameter rod, and weld it to the shackle stubs at the lock. Before doing this, cut V-grooves in the stubs to receive the V-shaped ends of the new shackle, thus providing a good joint when welded.

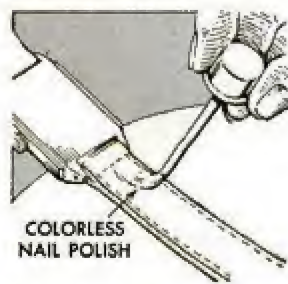
Saddle Block Makes Safe Pusher For Work on Bench Saw

To assure the greatest possible safety to his hands and fingers when cutting small wooden blocks and strips on his bench saw, one carpenter uses a saddle-block type of pusher stick, which straddles the ripping fence.

An additional feature of the block is that it is not so easily mislaid as the usual type.



Nail Polish Protects Watch Strap



Perspiration from the arm will cause an ordinary leather strap for a wrist watch to rot within a few months, but it can be protected very easily with a couple applications of clear nail polish,

allowing the polish to dry between applications. The polish will seal the pores of the leather and make it practically waterproof. Additional applications of polish will give the strap a plastic-like appearance, although this is unnecessary except from a decorative standpoint.

—Kenneth Murray, Baltimore, Md.

Miniature Display Flags Stiffened By Ironing Under Waxed Paper

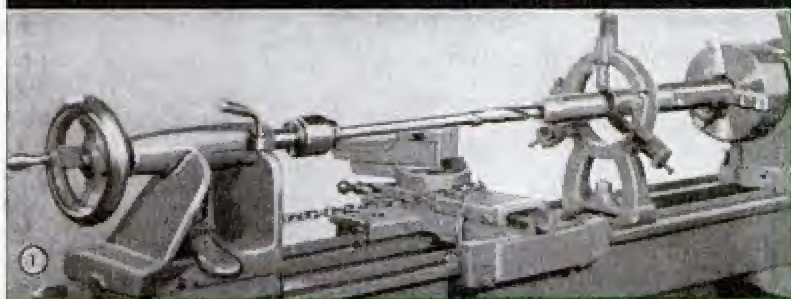
Small display flags that are stiffened with starch often become flimsy and wrinkled in damp weather. When this happens, just iron the flags smooth under sheets of waxed paper. Heat from the iron imparts some of the wax from the paper to the cloth, stiffening it and protecting it against moisture.



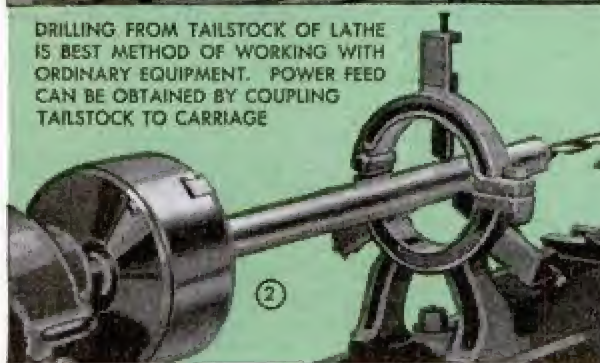


SHOP NOTES

Drilling DEEP HOLES in Metal

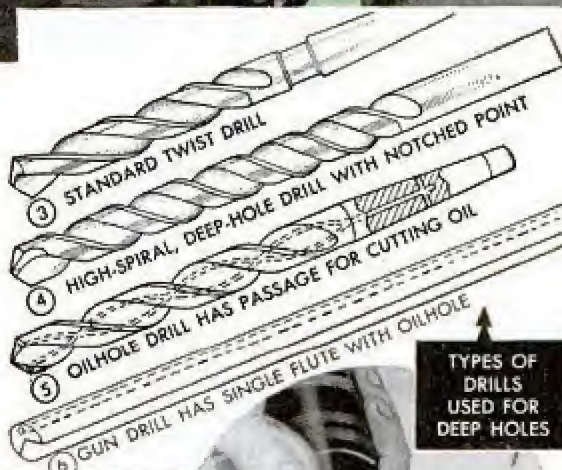


DRILLING FROM TAILSTOCK OF LATHE IS BEST METHOD OF WORKING WITH ORDINARY EQUIPMENT. POWER FEED CAN BE OBTAINED BY COUPLING TAILSTOCK TO CARRIAGE

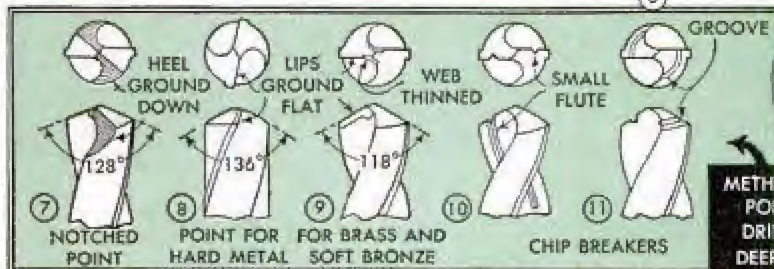


DRILLING cylindrical work from the lathe tailstock, as shown in Fig. 2, is practical for either shallow or deep holes. This method is accurate, easy to set up, and will handle the average job nicely. A power feed, if desired, can be obtained by coupling the tailstock with the carriage by means of a chain, as shown in Fig. 1.

The occasional job of deep-hole drilling can be done with a standard twist drill. For regular work of this kind, the drills shown in Figs. 4, 5 and 6 are preferable. Fig. 4 shows a high-spiral type of twist drill made



TYPES OF DRILLS USED FOR DEEP HOLES



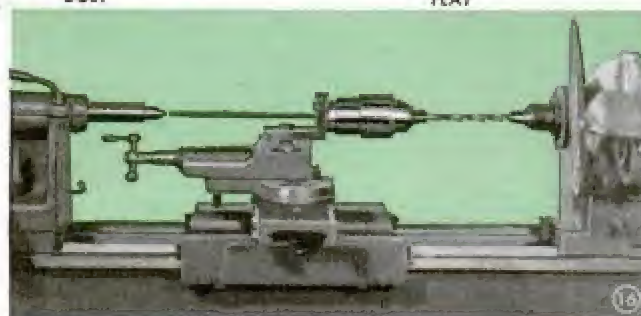
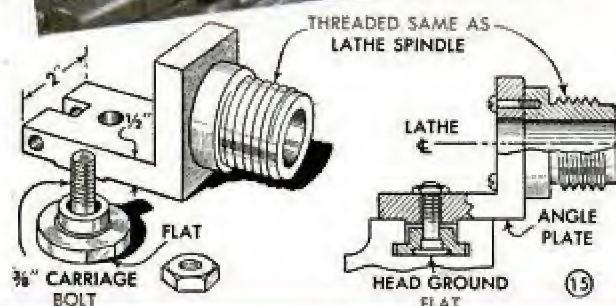
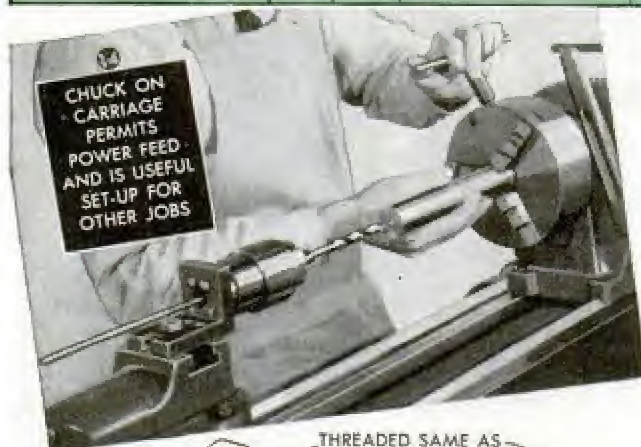
METHODS OF POINTING DRILLS FOR DEEP HOLES



★ ★ 13 DEEP-HOLE DRILLING PRACTICE WITH STANDARD TWIST DRILLS ★ ★

Material	F.P.M.*	Feed	Cutting Comp.	Style of Drill Point
Aluminum	250	Depends on drill size:	50-50 Kerosene and Lard Oil	Sharp point—90° to 110° included angle
Brass and Soft Bronze	200	Under 1/8"—.001 to .002 in. per revolution	Dry or Soluble Oil	Standard 118° point with cutting lips flattened
Soft Cast Iron	120	1/8" to 1/4"—.002 to .004	Dry	90° to 118° included angle
Soft Steel	110	1/4" to 1/2"—.004 to .008	Soluble Oil, Mineral Lard Oil or Sulphurized Oil	Notched point, 118°
Tool Steel	60	1/2" to 1"—.008 to .015		125° to 135° included angle—angle increases with hardness
Cast Plastic	250	Over 1"—.015 to .025	Dry (withdraw drill frequently)	118°—Relieve heel as shown in Fig. 7 but without notching web

* For high-speed steel drills



tracking of all drills used in deep-hole drilling.

You can drill to almost any depth with a standard type of twist drill by simply back-tracking the drill frequently. The hole should be drilled about one diameter or less, after which the drill should be withdrawn completely. This cycle of operations clears the hole of chips, allows the drill to cool, and gradually wears away any hard spots on the walls of the hole. If the drill is not long enough, a shank of suitable length and diameter can be welded on. One important thing to check is the margins of the drill. A high, clean margin is absolutely necessary—don't try deep-hole drilling with a drill that has margins worn away, especially within 1 in. of the lips.

Special pointing of the drill is sometimes helpful. Fig. 7 shows the best all-around point for deep-hole drilling. The included angle is 128 degrees, which is a bit sharper than the normal 118 degrees. The web is thinned by grinding away the heel, as shown. This drill penetrates easily, the notched point eliminating the non-cutting web of the standard twist drill. If the work is very hard, a blunt point, as in Fig. 8, with the cutting lips slightly flattened, will cut and hold up better. The same treatment of flattening the lips is required when drilling brass, Fig. 9,

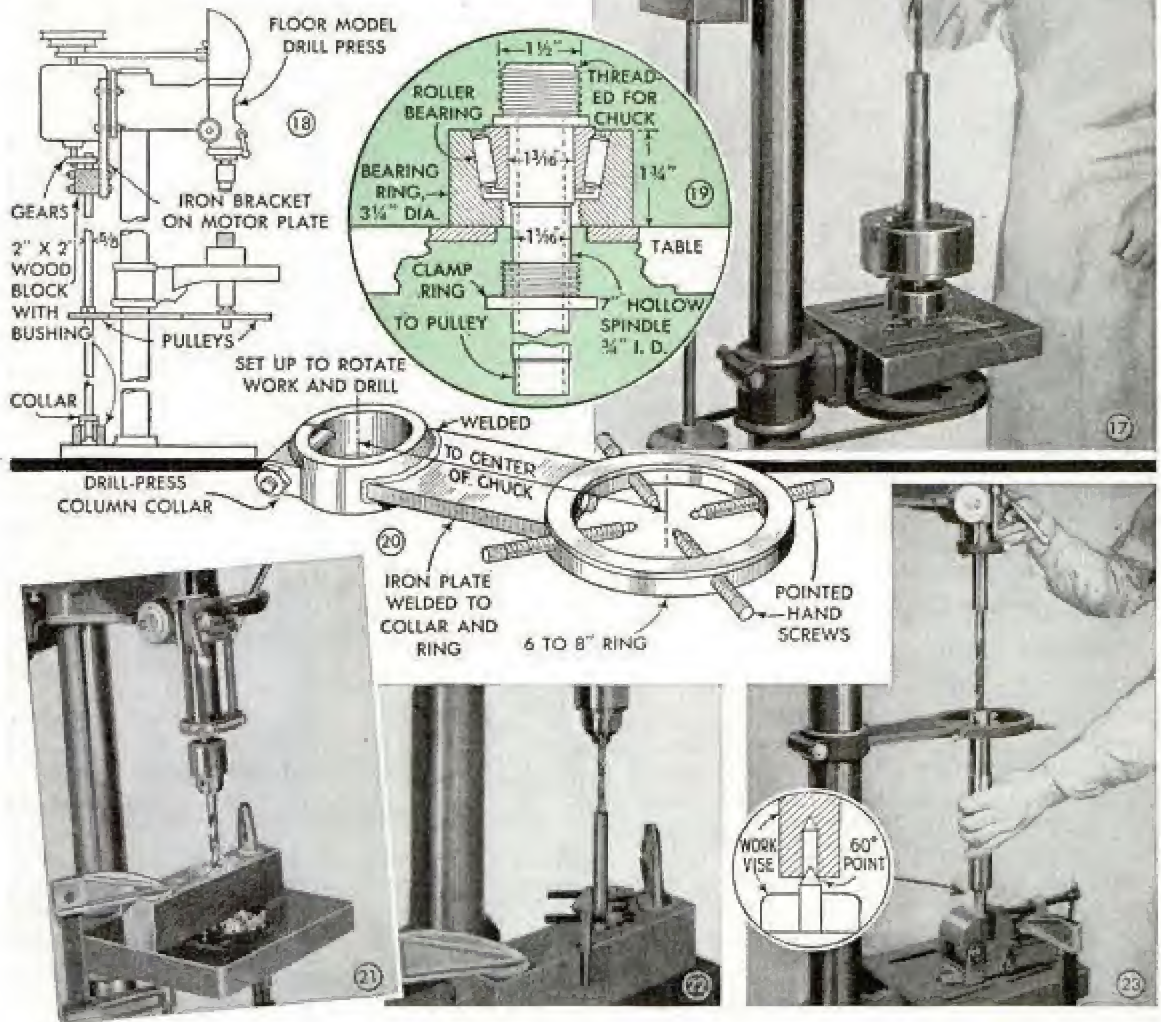
especially for deep-hole work (sometimes called a crankshaft drill). Other than the fast twist, which gives better chip elevation, this drill differs from a standard twist drill in that it has a notched point. Fig. 5 shows a standard twist drill with oil holes through the solid metal. It requires a special socket which permits coupling to a force-feed oil line. The cutting oil cools and lubricates the drill, and washes the chips out through the flutes. The gun drill, Fig. 6, also works on the force-feed system, chips being washed out through the single flute. Properly supported, it is the truest

but in this case the included angle is the standard 118 degrees. Fig. 9 also shows web thinning by grinding with a round edge wheel. A moderate amount of this is good practice, especially on larger drills.

Figs. 10 and 11 show two styles of chip breakers. The purpose of a chip breaker is to divide and break up the chip so that it can be expelled readily through the flutes of the drill. In factory-made drills of this style, the chip breaker consists of one or more flutes within the main flute, as in Fig. 10. A simpler style for occasional work is shown in Fig. 11, where the chip-breaking

flute is ground on the end of the drill. Fig. 12 shows how the work is done with a hand grinder fitted with a cut-off wheel.

A summary of drilling practice with standard twist drills is given in Fig. 13. Power feed is sometimes a desirable feature because it keeps the chip uniform and unbroken. Besides the chain method shown in Fig. 1, power feed on the lathe can be obtained by drilling from the carriage, as shown in Figs. 14 and 15. This set-up is



easily aligned by using a straight rod or the drill itself, as in Fig. 16.

When the work is done on the drill press, various methods can be used to assure an accurate hole. Many machinists rotate both work and drill, as shown in Figs. 17, 18 and 19. The diagram, Fig. 18, shows a 1:1 ratio from motor to pulley spindle, but a reduction of 2:1 is better as it decreases vibration and gear noise. A further reduction is obtained by the pulleys, so that the final speed of about 200 r.p.m. is obtained.

Figs. 21 and 22 picture one of the best methods of drilling round work of small diameter. A wood block is clamped to the

drill table and a drill of the same diameter as the work is used to run a hole into the block, as in Fig. 21. Then the work is mounted in the hole, with the actual work drill in the drill chuck as in Fig. 22. Note that the drill table and the wooden block remain in a fixed position.

In drilling long work on a drill press, the biggest difficulty is holding the work upright. For this purpose, the ring shown in Fig. 23 is excellent. The bottom end of the work is supported on a 60-degree point held in a drill vise, the point being aligned exactly below the drill point previous to the drilling operation.

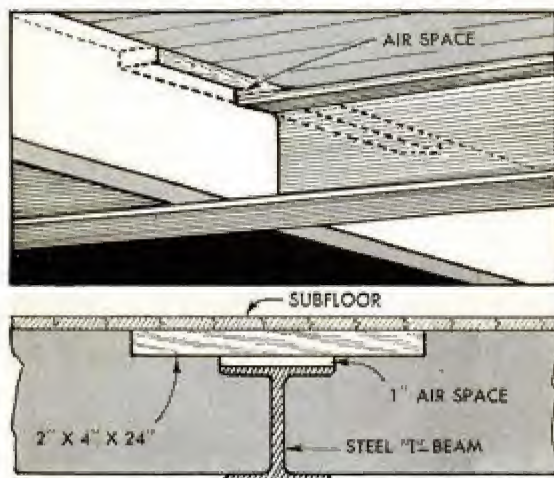
Easy Way to Hold a Blowtorch While Filling the Tank



The problem of holding a blowtorch in an inverted position while filling the tank was solved by one workman who hooked it over a nail driven into the workbench top near one edge. To do this, a small hole was drilled through the rim of the torch tank as indicated. With this method of holding the torch, both hands are free to hold the gasoline can while filling the tank.

Shrinkage Space Avoids Bulge Above Steel Support

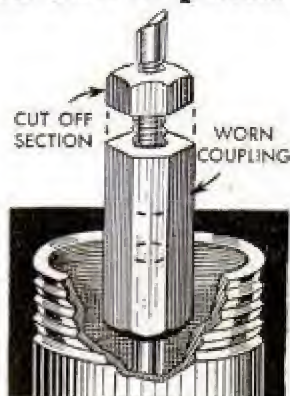
Whenever steel I-beams are used as supporting members for the ends of heavy wooden floor joists, an air space should be provided between the joist ends directly above the beam. If this is not done, shrinkage of the joists, or contraction and expansion, which is widely different between the wood and metal, may cause the floor boards to bulge. The air space allows for vertical movement of the floor above the beam, and is made by notching the ends of the joists



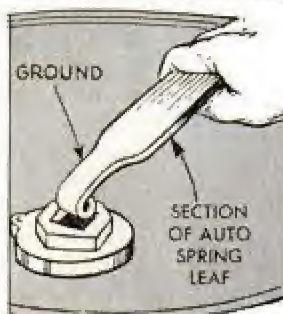
to form two recesses above the beam as indicated. One recess is about 1 in. deep and of the same width as the beam, and is bridged by a length of 2 by 4-in. stock, which sets in the longer second notch flush with the upper edges of the joists to support the floor boards.

Coupling Locked on Pump Rod

While on a job of repairing a well pump, the workman noticed that one of the couplings on the pump rod was loose and could not be tightened securely because of worn and rusted threads. As no new coupling was available, a good repair was made by sawing off one end of the coupling as indicated, and then using this as a lock nut to secure the connection.



Wrench Loosens Oil-Drum Plug



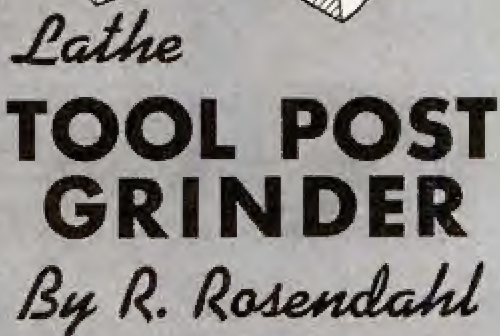
Annoyed by having some of the workmen carry away a wrench used for loosening the plugs in oil drums, one garage mechanic ground down the eye end of an auto-spring leaf so that it would fit into the

plug. This served even better than the wrench formerly used as it would not get out of adjustment, and since it could not be used for other purposes, there was no reason for carrying it away.

Sandpaper Cone Lifts Eggs

To simplify the removal of eggs from the case fillers for candling, one merchant employs a cone made of coarse sandpaper. The cone is rolled with the rough side in and is held permanently in shape with strips of gummed paper tape. Pressed down over an egg, the cone lifts it easily, and may be detached by a slight pressure of the fingertips.





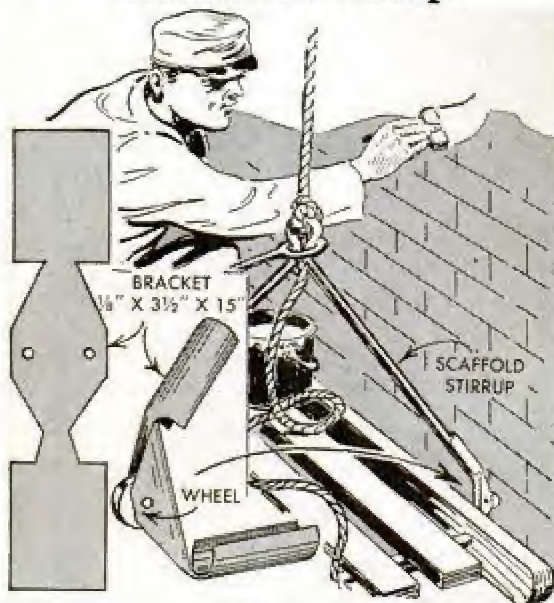
APRIL, 1944



Replacement of Clock Gears Aided by Paper Pattern

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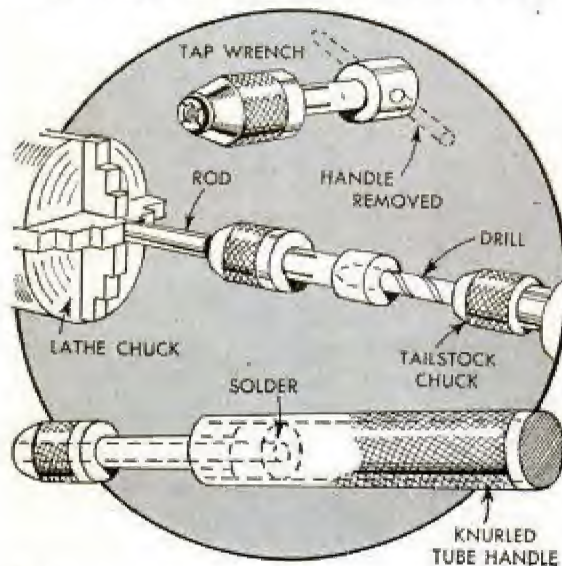
Improving Scaffold With Wheels Bracketed to Stirrups



Wear on scaffold stirrups can be prevented, and the scaffold made easier to raise or lower if a bracket carrying a small wheel is attached to each stirrup at the spot where it ordinarily would rub against the wall of a building. The bracket is cut from $\frac{1}{8}$ -in. steel, with the center bent out as shown to take the wheel, which can be a roller-skate wheel or any other suitable one. The ends of the bracket are bent in the opposite direction and hammered around the stirrup.

Tap Wrench Made Into Pin Vise For Use With Large Stock

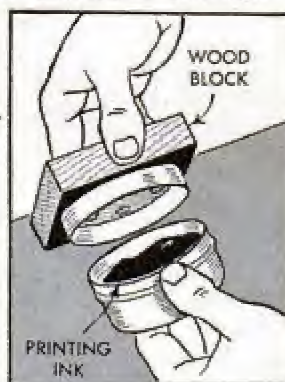
A pin vise capable of handling $\frac{1}{4}$ -in. round stock can be made from a standard tap wrench. After the handle bar is driven out, clamp a rod of maximum diameter in



the wrench and chuck the other end of this rod in the lathe. Using a drill of the same diameter as the rod in the tailstock chuck of the lathe, complete the hole lengthwise through the tap wrench. A piece of steel tubing is knurled on the outside for a handle. With the head of the tap wrench turned down to the right size, it may be driven into the handle and soldered in place. Remove the rod, give the tool a careful cleaning, and the converted wrench is ready for use as a pin vise.

Printing-Ink Cans Open Easily When Block Is Tacked to Lid

To remove the covers of printing-ink cans without battering and pounding, one printer tacks the covers onto wood blocks. These blocks provide a firm grip for the fingers, by which the covers may be loosened and removed instantly.



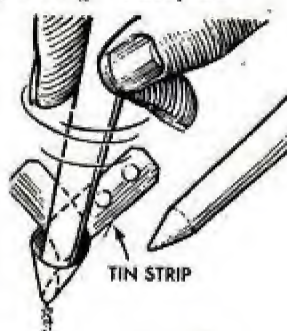
Handle Is Held Securely on File By Hook Point on Tang



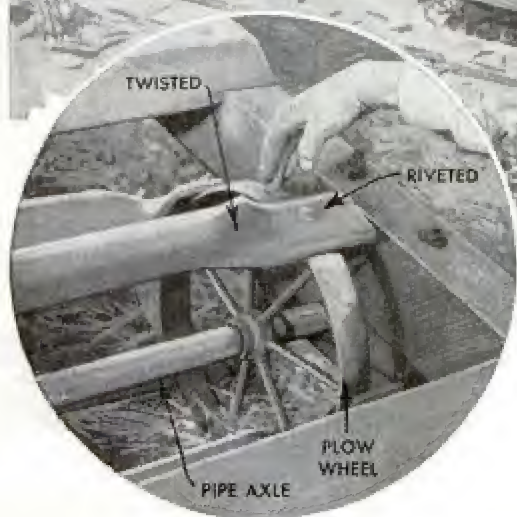
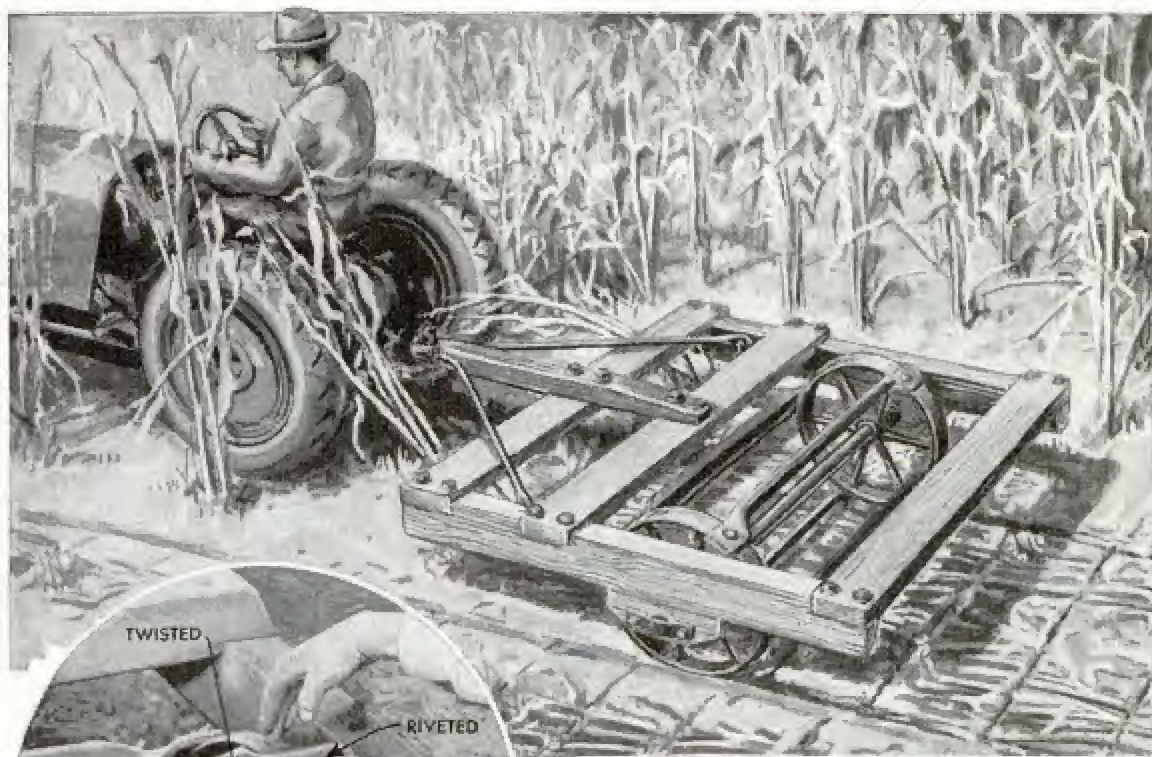
If you are troubled by having the handle of a file loosen, grind the tang end to a sharp point, then heat and bend it to form a hook as indicated. When the tang is forced into the handle, the hook will anchor firmly in the wood and hold the handle securely.

Tin Strip Provides Sharpener For Pointing Shop Crayon

For sharpening crayon or chalk for shop use, one workman twisted a strip of tin as shown and tacked it to the wall. The free end provides a blade and the crayon is pointed by inserting and turning it.



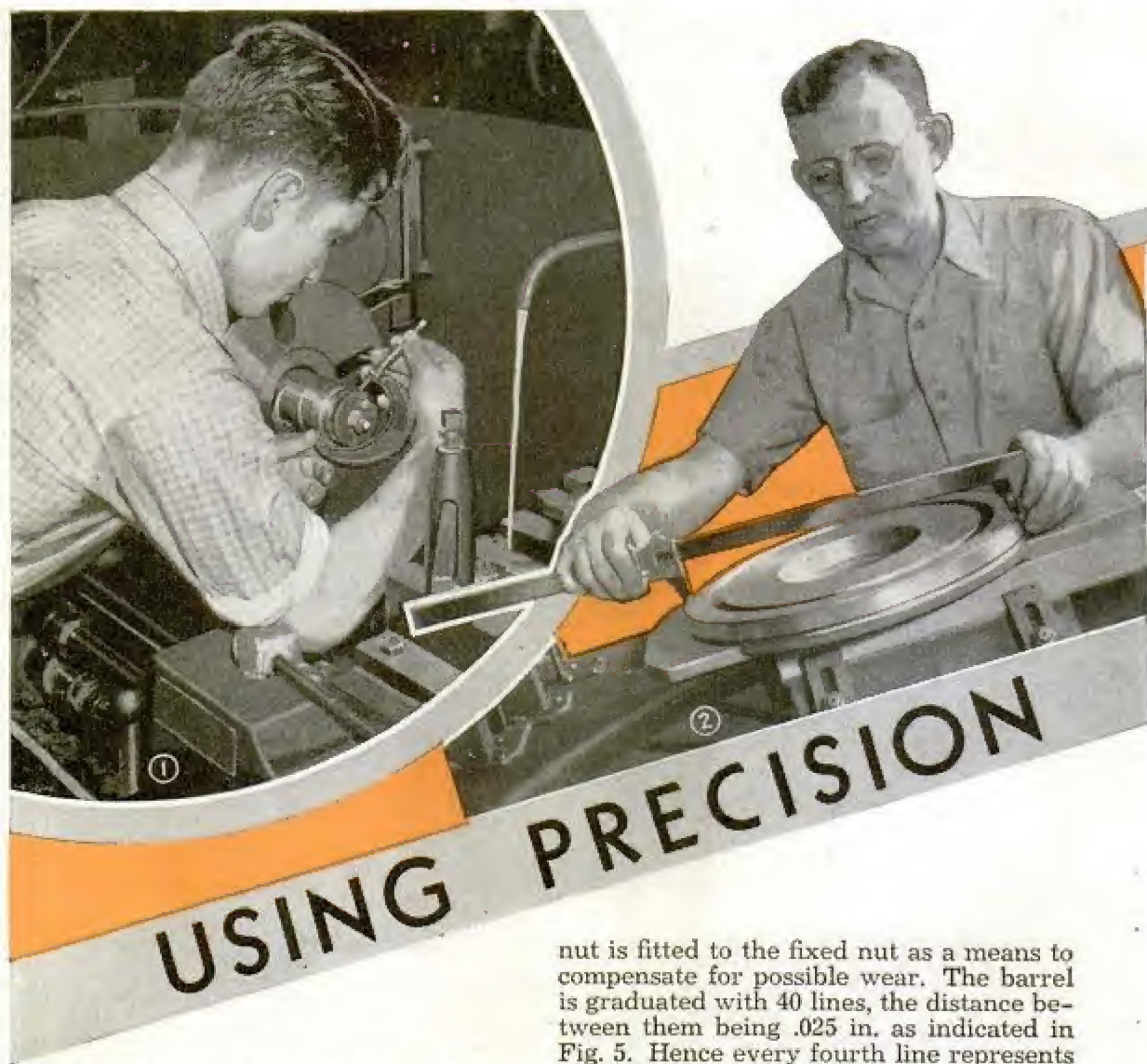
Two-Row Cornstalk Cutter From Scrap Material



Covering two rows at a time, this cornstalk cutter will save time, and costs very little to make, especially if you have some scrap lumber and a couple of small implement wheels available. On the original, two plow wheels were used, and a length of pipe served as an axle. Old road-grader blades were used for the cutters, but other pieces of flat, scrap steel will do, provided they are tempered to hold a sharp edge. The cutters are given half twists near the ends by forging and then are riveted to the wheel rims, spacing them equally around the wheels. For the frame, use 4 by 4-in. stock or heavier at the sides and 2 by 6-in. stock for the crosspieces. Bearings are hardwood blocks, preferably maple, drilled to receive the axle, the bearing holes being capped at the outside with pieces of flat iron to keep the cutter assembly centered in the frame. With this arrangement the wheels are pinned to the axle. However, if it is desired to have the wheels turn on

the axle and thus provide bearing surfaces more resistant to wear than wood bearings, the axle is held rigidly in the frame and is drilled for large cotter keys at the inner sides of the wheel hubs to keep the assembly centered. Spring teeth from a hay tedder are fastened near each end of the front crosspiece to drag on the ground and turn all cornstalks at right angles to the cutter so they will be chopped into short pieces. Although the original cutter was fitted with a stub tongue for pulling with a tractor, horses can be used if a longer tongue is provided. If this is done, the tongue should be set to one side of the cutter center so that the horses can walk between the cornstalk rows instead of on them.

—A. M. Wettach, Mt. Pleasant, Ia.



By H. J. Chamberland

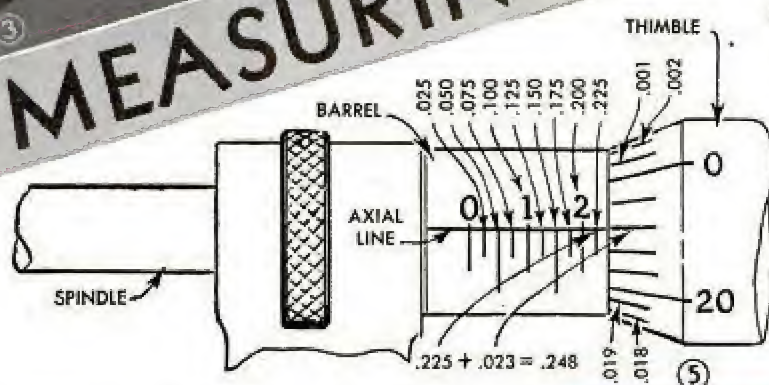
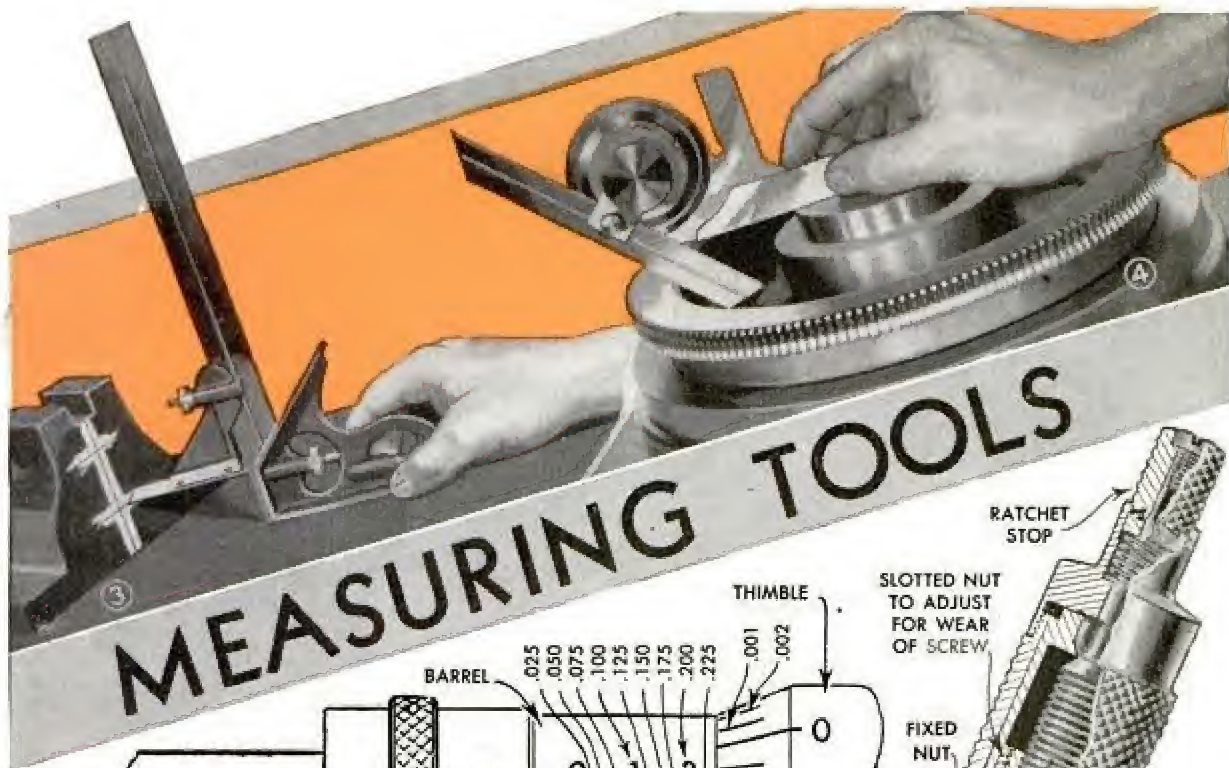
WHEN speaking of precision measuring tools such as used by machinists, toolmakers and machine operators we usually refer to types graduated to read in thousandths and tenths of thousandths inch or in degrees and minutes. The four most outstanding and generally used precision measuring tools are the micrometer caliper, Fig. 1, vernier caliper, Fig. 2, universal bevel protractor, Fig. 4, and the combination square, Fig. 3, which is a precision measuring tool when used in connection with its attachments.

Micrometer caliper: This tool, commonly called a micrometer or "mike" measures one-thousandths of the standard inch. It consists of two engaging parts which can be separated when necessary. As shown in Fig. 6, one part consists of the frame and barrel which are integral. A fixed nut is fitted internally to the barrel and a slotted

nut is fitted to the fixed nut as a means to compensate for possible wear. The barrel is graduated with 40 lines, the distance between them being .025 in. as indicated in Fig. 5. Hence every fourth line represents .1 in., being marked 0, 1, 2, 3, etc. The 40th line is marked 0 as is the first. The total distance between the two 0 lines is therefore 40 times .025 in. or 1000 thousandths of an inch.

The other part of the micrometer consists of an accurate screw-spindle to which the thimble is fitted. The screw-spindle rotates inside the barrel and the thimble on the outside. The latter has 25 graduations on its beveled edge and every fifth graduation is marked 0, 5, 10, 15 and 20 with the 0 representing the 25th. One complete revolution of the thimble is equal to one spacing on the barrel, or .025 in., and as the thimble is divided into 25 equal parts, it follows that one of these parts represents .001 inch.

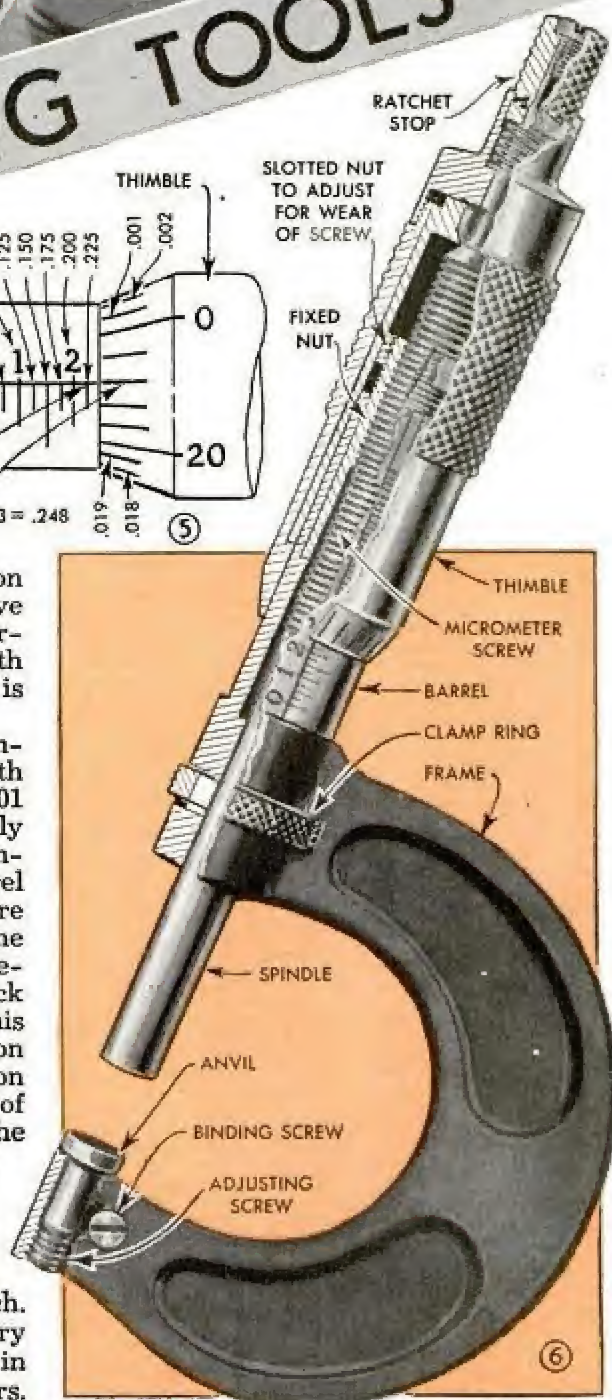
How to read a micrometer: First read the highest figure showing on the barrel, which in Fig. 5 is .2 in. To this you add .025 in. for every line visible between this figure and the edge of the thimble, which in the example makes a total of .225 in. To

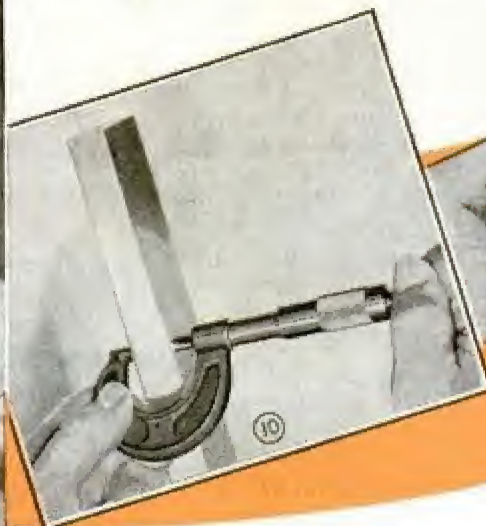
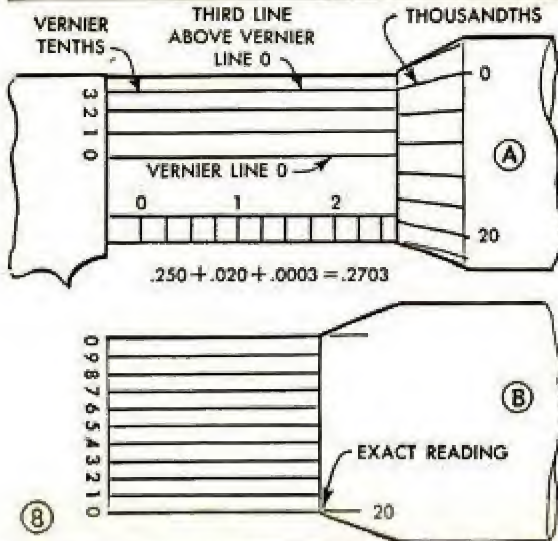


this total is added the number of lines on the thimble which coincide with or have passed the parallel or axial line on the barrel. In Fig. 5 the 23rd line coincides with the axial line. Thus the total reading is .248 inch.

For closer measurements many micrometers are graduated to divide a thousandth inch into ten parts each representing .0001 in. As shown in detail A of Fig. 8, the only difference between this and other micrometers is 10 horizontal lines on the barrel known as vernier divisions, which are marked as shown in detail B. Note that the axial line is lowered to permit this arrangement. To read in tenths, you first check the number of thousandths which in this case is .250 plus .020, as the 20th line on the thimble has passed the axial line on the barrel. Then you count the number of lines on the thimble that are above the vernier line 0 until you note a line on the thimble and one on the barrel coinciding. In this case it is the third line on the thimble and the .0003-in. line on the barrel, thus giving a compiled reading of .250 plus .020 plus .0003 or .2703 inch.

Method of using: Fig. 1 shows a very good way to use a micrometer on work in a machine but not held between centers.



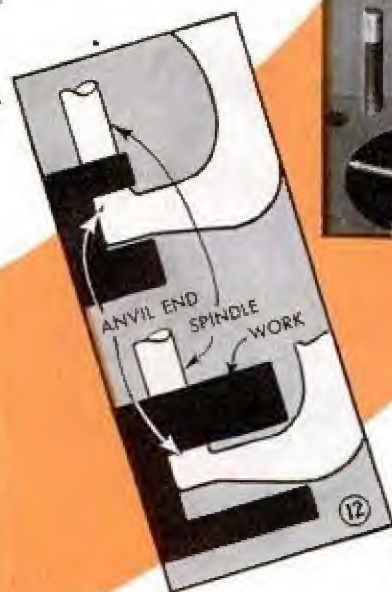


When possible the micrometer should be read before removing it from the work because a slight movement of the spindle while the mike is slid off the work might result in an incorrect reading. With the micrometer in this position the operator is facing the graduations, whereas in Fig. 9, when the work is between centers, the reading has to be observed from the left, or else the micrometer must be removed carefully from the work. Fig. 9 also shows the proper way to hold a micrometer on work mounted between centers. Its weight should be entirely supported with the hand holding the frame, leaving the other hand free to control the thimble for spindle contact without any undue pressure. Beginners will obtain closer readings and a micrometer will last much longer if it is equipped with a ratchet stop as shown in Figs. 6, 10 and 11. The ratchet stop prevents squeezing the work, which results in wear on the fine threads of the screw and also on the measuring faces. Fig. 11 shows how a micrometer is held in measuring small cylindrical parts. Note how the micrometer is supported in the palm of the hand and is held so it can be read easily.

Although individual micrometers are available for measurements of 1 to 12 in., a set is rather expensive and therefore a micrometer as shown in Fig. 7 is economical. It consists of a frame and a set of interchangeable anvils varying 1 in. in length. Each anvil is also adjustable to compensate for wear, and measuring rods or "checks" are furnished to maintain over-all precision. The larger the micrometer, the more care must be exercised to hold it rigidly so that no pressure is transmitted to the spindle. When measuring large work, the micrometer must necessarily be moved back

and forth delicately while establishing spindle contact. All micrometers larger than 3 in. should be held as in Fig. 7. To get into narrow or deep slots, some micrometers have anvil ends as shown in Fig. 12.

Various types of micrometers: Fig. 15 shows a screw-thread micrometer, used to measure the pitch diameter of threads. The anvil is free to rotate into alignment. The tool shown in Fig. 14 is an inside micrometer used to replace plug gages for measuring holes from approximately $\frac{7}{32}$ to 1 in. diameter. The inside micrometer shown in Fig. 13 is the telescoping type and holes up to 12 in. in diameter can be measured to within .0005 in. This tool has interchangeable measuring rods, the measuring points adjusting themselves to the cylindrical surface automatically, after which they are locked by turning the knob on the end of the handle. Then the tool is carefully withdrawn from the hole, the thimble turned



to which is precisely fitted a slide having an opening. The long scale is graduated somewhat like the barrel of a micrometer, having 40 divisions per inch, each being .025 in., and

every fourth line is a .1-in. division. To the slide is attached the vernier scale having 25 graduations numbered at every fifth line.

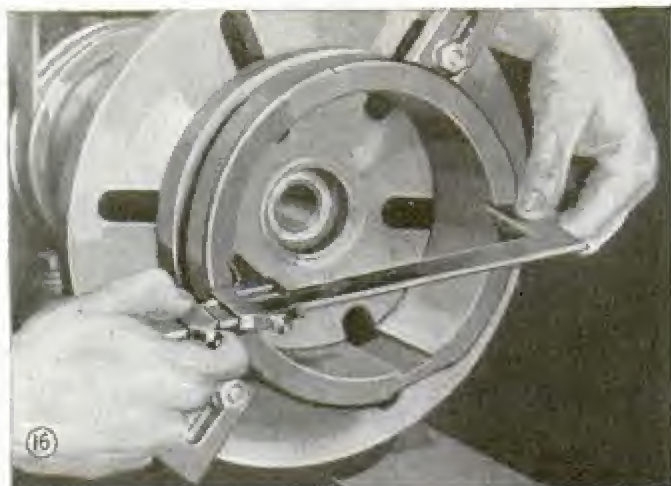
If the distances between the 25 lines on the vernier scale and 25 lines on the large scale were precisely alike, they could all be made to coincide simultaneously. However, the 25 divisions on the vernier scale equal in extreme length only 24 divisions on the large scale, meaning 24 times .025 or .6 in. Therefore the distance between the two lines of the vernier scale is .6 divided by 25, giving .024 in. or a difference of .001 in. between lines of the small scale and those of the large scale. When the 0 on the vernier scale is in line with a certain line on the large scale, the reading is exact.

To compute the reading as shown in Fig. 17 use a reading glass. Note that the 0 on the vernier scale has not reached the 6th figure of the second inch on the large scale. So, as with the micrometer, you add to the .5 in. the three preceding .025-in. divisions, which gives thus far 1.575 in. Now you start with the 0 on the small scale and, reading to the right, you find that the 14th line is the first line on the vernier scale

until making contact with the shoulder of the rod and the reading taken.

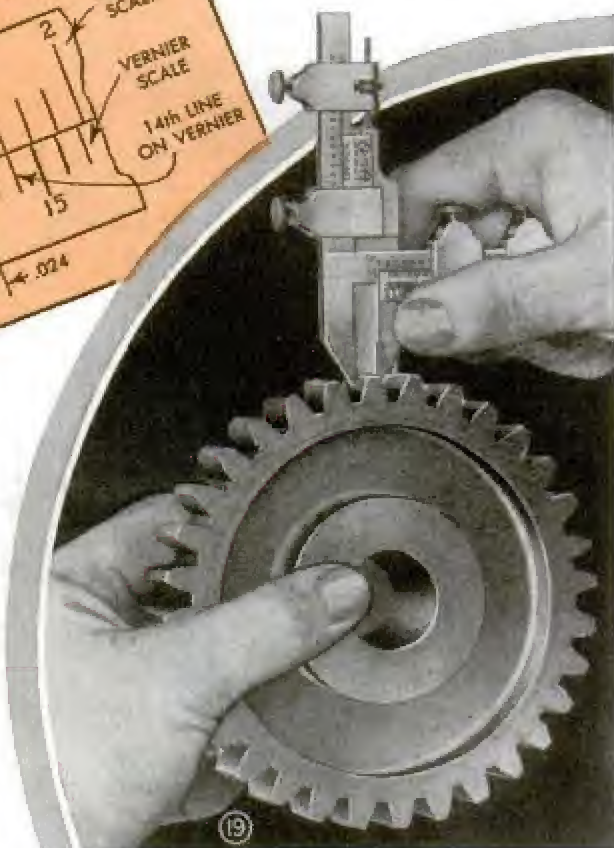
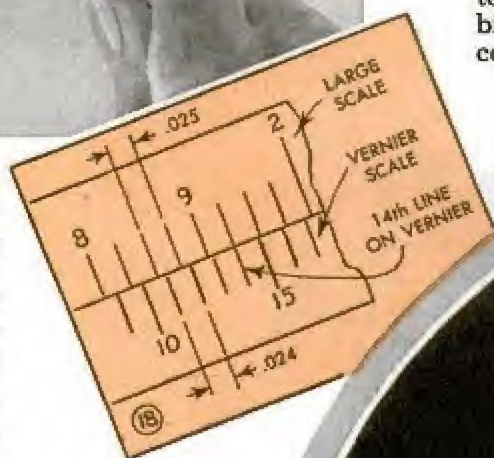
Vernier caliper: The vernier caliper

shown in Fig. 16 could be called a high-precision slide rule and described as a micrometer having graduations on flat rather than on cylindrical surfaces. The vernier caliper is intended to measure externally as in Fig. 2 and internally as in Fig. 16. As shown in Fig. 17, it consists of a long scale



to coincide with a line on the large scale. Therefore the exact distance between the measuring faces is 1.575 plus .014 or 1.589 in. Fig. 18 is a closeup view of the reading in Fig. 17 between the .8 and the 2-in. lines of the large scale. Graduations on both scales are enlarged to show the coinciding of the 14th line of the vernier scale.

Fig. 2 shows how a vernier caliper should be used to check external measurements; the user holds the end measuring face against the work while the slide is adjusted by means of a fine thread screw to create the proper contact from this opposite measuring point. Precise measurements are obtained as with a large micrometer by simultaneous "feel" and delicate back-and-forth movement. As shown in Fig. 17, some vernier calipers are graduated on both sides so they can be read for both external and internal meas-

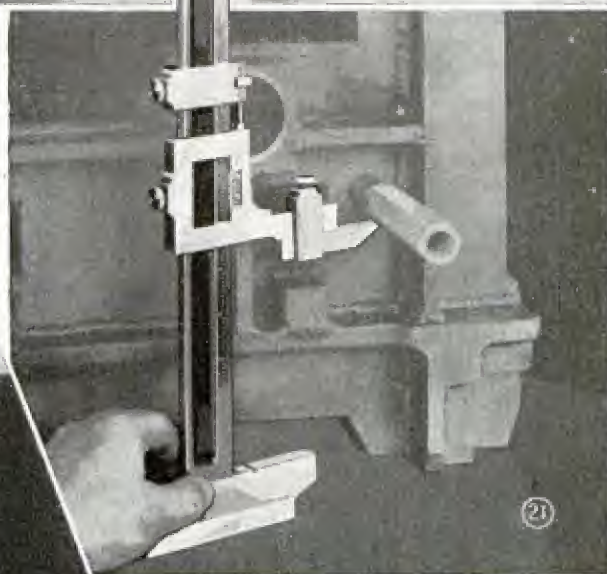
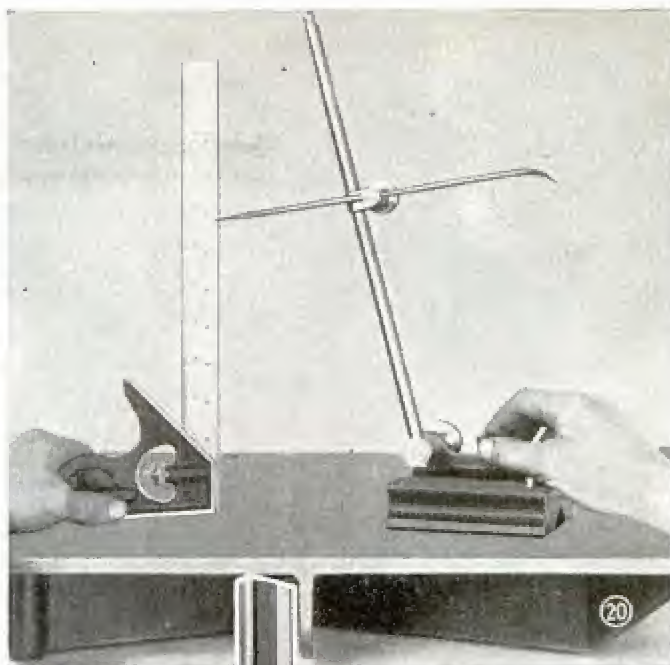


urements. When a vernier is graduated for external use only, the thickness of the measuring points must be added to the reading of the internal measurements.

The two-in-one vernier shown in Fig. 19 serves the same purpose as the micrometer shown in Fig. 15, but is used on gear teeth. Fig. 20 shows a universal surface gage being set to a desired height with the figures of the scale of a combination square, the purpose being to locate a plate or casting. An experienced machinist can work to close figures, but such an arrangement is not precise to the thousandth as when using a vernier height gage such as shown in Fig. 21. In Fig. 22 is shown another type of height gage which can be set to within .001 in. with a micrometer caliper. This tool is chiefly used to set up height of shaper and planer tools from table.

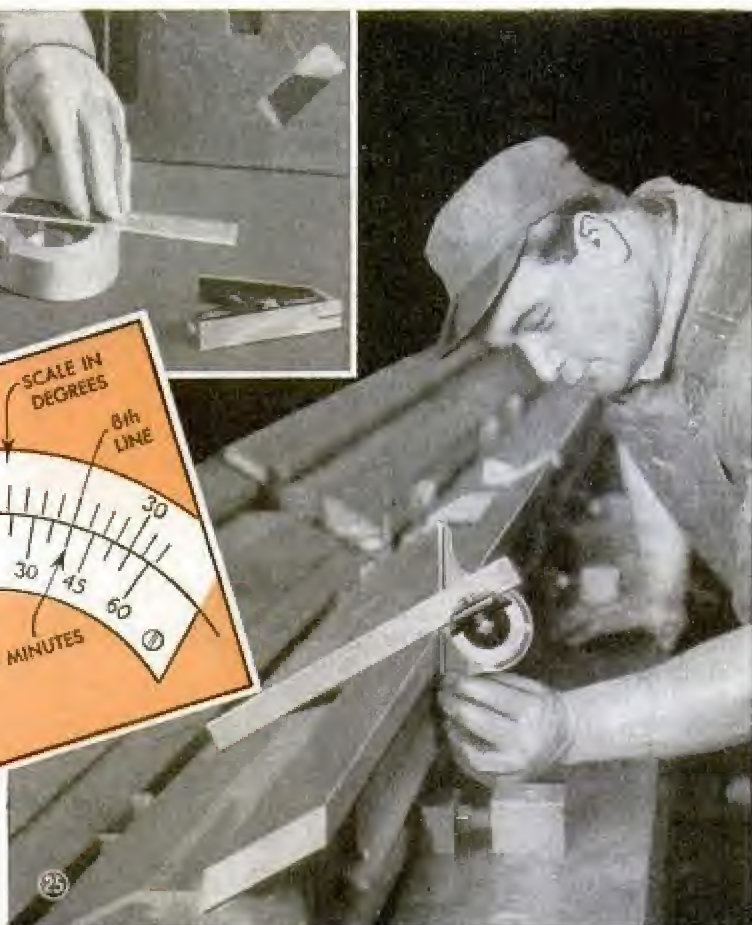
Plain and universal bevel protractors: Besides its use with a height-gage attachment, Fig. 3; with a surface gage, Fig. 20; as a depth gage, Fig. 23, and as a centering tool, Fig. 24, the combination square is used in connection with a plain pro-

tractor head as shown in Fig. 25. A bevel protractor of this type is quite accurate to obtain angular measurements in degrees but it is only graduated over an arc of 180 degrees reading from 0 to 90 degrees on each extremity of the arc. Closer precision demands a universal bevel protractor such as shown in Fig. 4, which has graduations over the entire dial. This protractor also incorporates the vernier system to divide a degree into divisions of 5 minutes or $\frac{1}{12}$ of a degree. As shown in Fig. 26, the dial is graduated in degrees and the vernier scale has 12 divisions on each side of the 0, each representing 5 minutes. With the protractor, each space on the vernier is 5 minutes or $\frac{1}{12}$ of a degree shorter than two spaces on the scale. When the 0 on the vernier coincides with a line or graduation on the dial, the reading is in exact degrees. If the 0 on the vernier does not coincide with one on the dial, as shown, the line that does coincide indicates the number of units of 5 minutes to be added to the number of degrees. In this case we find that when reading from 0 on the dial and to the right, the



0 line on the vernier is between the 15th and 16th degree lines. We therefore have a primary reading of 15 full degrees. Again reading to the right, but this time from the 0 line on the vernier, we note that the 8th line of the vernier coincides with one on the dial. As each line represents 5 minutes, we add 5 times 8 or 40 minutes to the previous reading which gives 15 degrees and 40 minutes as the exact measurement.

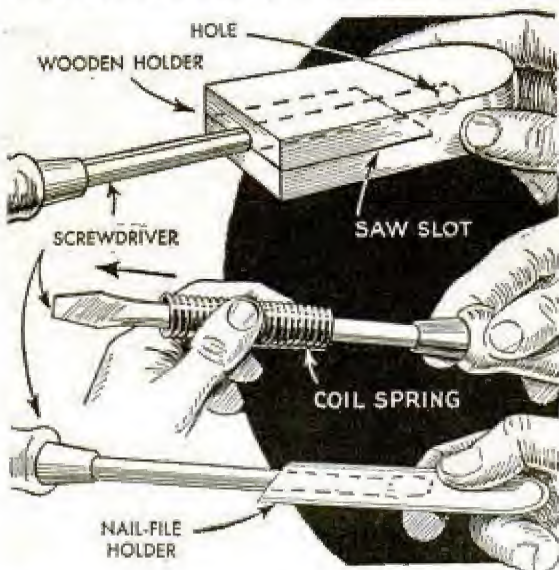
There are several other micrometer and vernier precision measuring tools which incorporate the principles outlined. Micrometers can be reset by experienced mechanics to compensate



for wear, but this should not be attempted by apprentices. Vernier calipers, vernier height gages and vernier bevel protractors must be returned to manufacturers for repairs. Micrometers used on work being ground should be cleaned by dipping in naphtha at least twice a week, both integral parts being cleaned separately. Every machine operator should have a so-called "roughing" micrometer if possible,

keeping the best one to obtain final measurements. Vernier calipers should never lie on a bench or machine table unless resting on a piece of paper or, preferably, cloth. They should be wiped clean with cheesecloth after being used and given a light coat of very light oil. This also applies to universal bevel protractors.

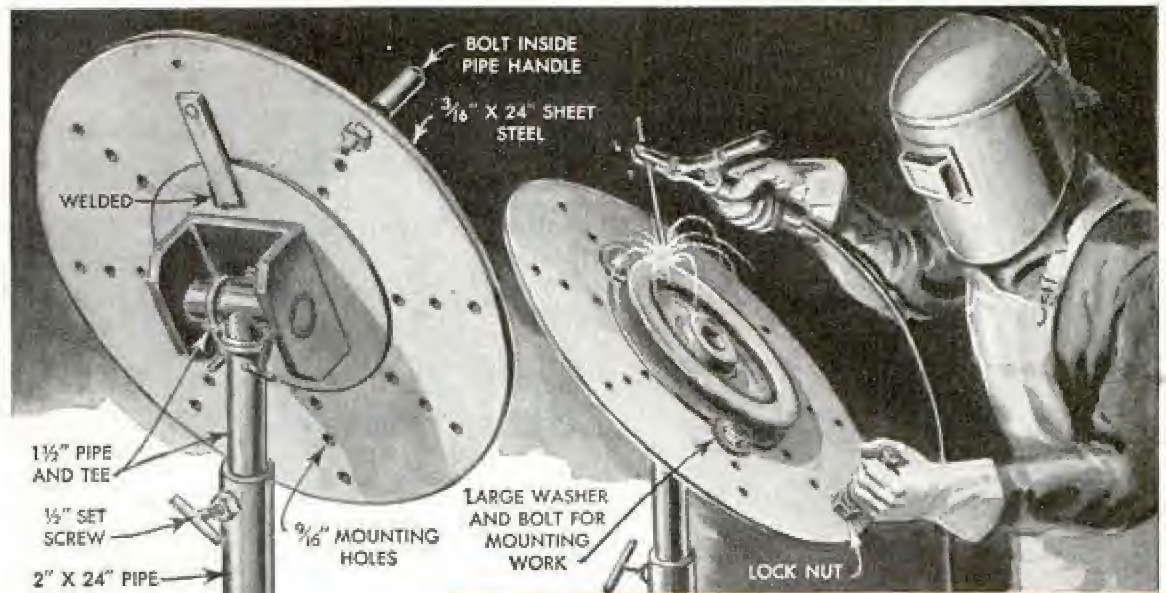
Screwdriver Blades Sheathed to Carry Safely in Pocket



To cover the blade of a small screwdriver so that it can be carried safely in the pocket, drill a hole a little smaller than the diameter of the screwdriver in a wood block, rounded on one end. A slot sawed into the block almost the length of the hole will accommodate the screwdriver blade, and the natural spring of the wood will hold the block on. Another method of covering the point is to wind a coil spring around the shaft of the screwdriver so that it fits snugly. When the screwdriver is to be put in the pocket, simply push the spring up so that it covers the head. An ordinary nail-file holder also makes a good cover.

☞ Cotton gloves dipped in melted paraffin will protect the hands while cleaning a printing press and type. Excess paraffin should be wrung out before it hardens.

Welder's Table Tilts or Rotates to Any Position



1 1/2" PIPE
AND TEE

1/2" SET
SCREW

2" X 24" PIPE

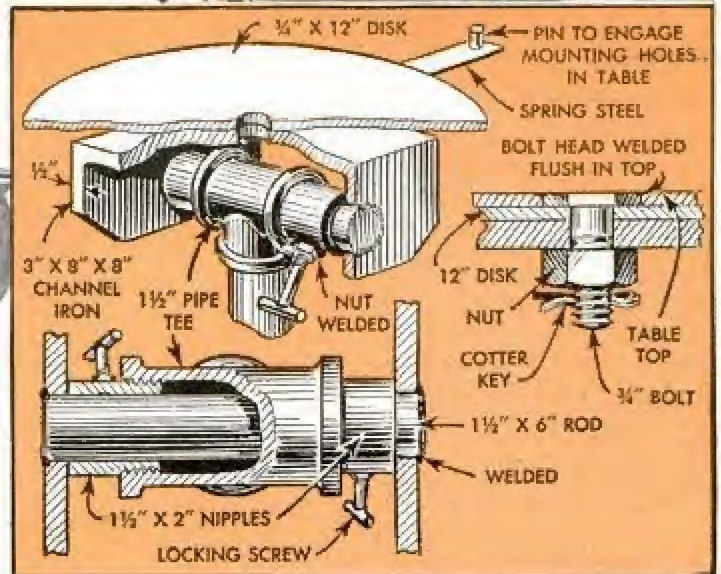
OLD GEAR
OR CONCRETE
BASE

WELDED

GROUND
WIRE

LARGE WASHER
AND BOLT FOR
MOUNTING
WORK

LOCK NUT



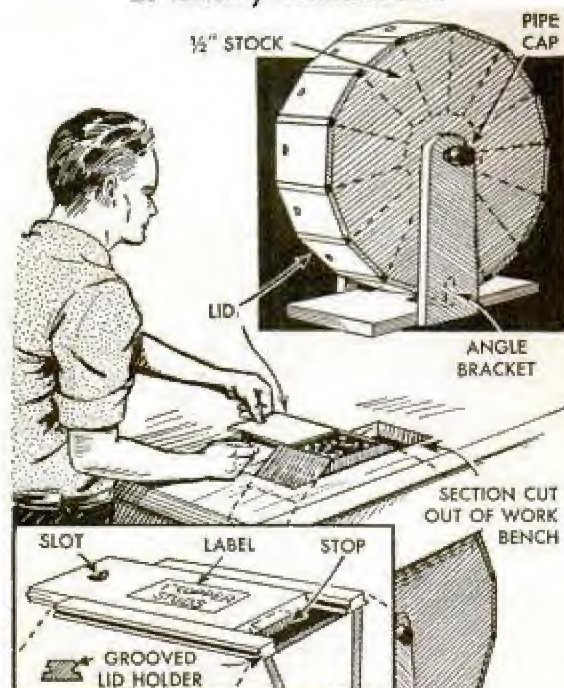
Welders will find that this table saves both time and labor, as it permits the work to be instantly moved to almost any position. The table is adjustable in height, tilts to any angle and the top can be rotated to bring the work to the most convenient position. An old gear or even a disk cast of concrete will serve as a base to which is attached a standard consisting of two lengths of pipe, one to slide inside the other. Height adjustment is held by a set screw fitted with a handle and threaded into a nut welded over a hole through the larger pipe. Short pipe nipples turned into a T-fitting at the upper end of the standard serve as bearings for an axle on which the table-top assembly rotates when tilted. The axle ends are welded into holes in a saddle of large channel iron to which the table top is pivoted. To hold the table in a tilted position, locking screws are threaded into nuts welded over a hole in each pipe nipple. The table top proper is a 24-in. disk of sheet steel, pivoted to the channel-iron saddle by a bolt, the head of which is

welded flush with the table surface. A 12-in. steel disk is placed between the table top and saddle and is welded to the latter to provide a wide bearing surface. Holes for mounting work are drilled through the table top, one being fitted with a handle. The table is locked in any position by a pin welded to a spring-steel strip, which is in turn welded to the 12-in. disk in a position that will permit the pin to engage holes in the table.—Bob York, Chicago.

Colors Identify Right Oil Can

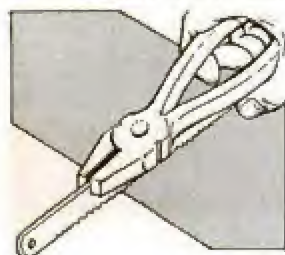
To make sure the right oil is used for certain purposes, one plant enamels all oil-cans, using a different color for each type of oil. Drums from which the cans are filled are similarly identified, as are the oil holes and oil cups on machines.

Rotating Parts Bin Under Bench Is Easily Accessible



By merely rotating this bin, small parts stored in any of its compartments can be brought to the top of the bench for easy access. Supported on an axle of pipe between two heavy uprights, the bin is placed beneath the bench, through which a slot large enough to allow it to revolve has been cut. The bin should be of a diameter to permit only the top of each compartment to project through the slot above the level of the bench top. Side pieces of the required diameter are cut from $\frac{1}{2}$ in. stock and marked off into as many equal parts as desired. After the bin partitions have been nailed to one side, a strip of tin or flexible fiber board may be bent around and attached to serve as a bottom for the compartments if it is not desired to fit in individual boards for this purpose. When the other side is nailed in place, holders are grooved to fit the lids and attached to the end of each partition. Washers of wood or leather between the uprights and the bin will keep the sides from scraping.

Using Hacksaw Blade in Places That Are Hard to Reach



The next time you have to use a hacksaw in a place where there isn't room for the saw frame, try holding the blade as shown. Grip it near one end with

a pair of pliers, letting the thumb and index finger extend downward to grip the blade behind the pliers. This will enable you to hold the blade stiff enough to permit taking strokes several inches long.

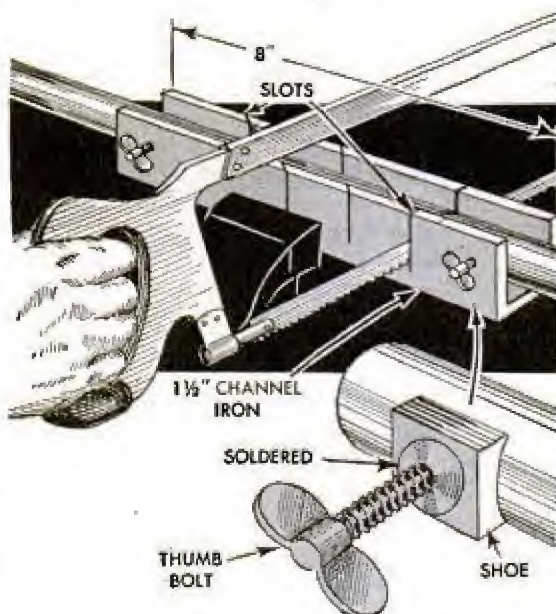
Hook-Point Knife Brands Meat For Locker-Plant Patrons

Due to the fact that smoking of hams and bacon would obliterate rubber-stamp marks to identify the finished products for various patrons, one manager of a locker plant employs a sharp, hook-point knife to brand these meats before they are processed. The initials or locker number of the patron are quickly carved in the meat rind and remain visible after processing has been completed.



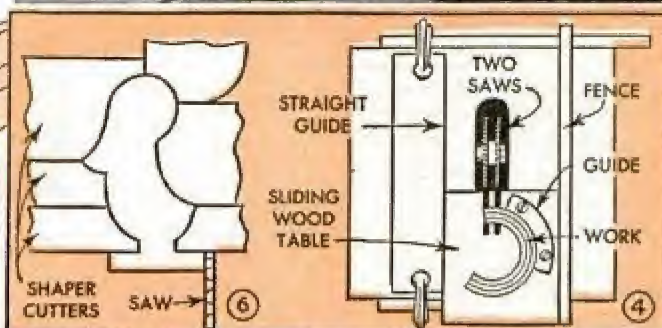
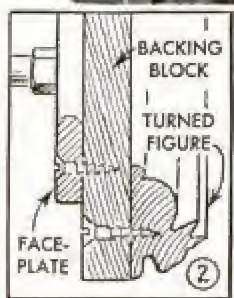
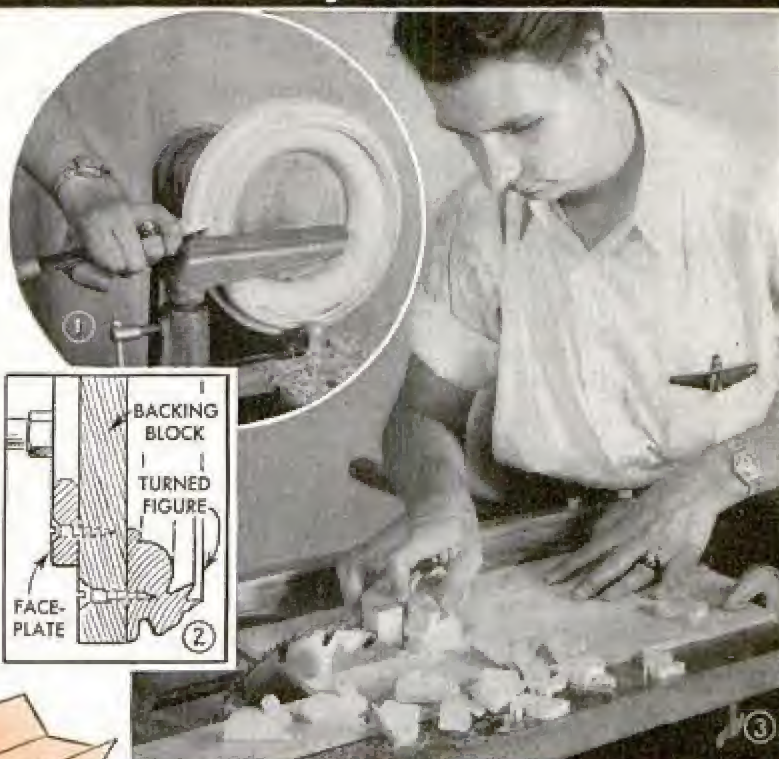
Pipe and Rod Are Cut at Angles In Channel-Iron Miter Box

Made from a length of $1\frac{1}{2}$ -in. channel iron, this miter box for cutting pipe and rods does not even require the use of a vise. Slots are cut at the required angles, and thumb bolts to which curved metal shoes have been soldered or welded to hold the round pieces are placed at the ends of the unit. To use the miter box, clamp the pipe or rod in place and saw through it with a hacksaw in the proper slot.



TWO PRODUCTION METHODS of MAKING CUTOUTS

SMALL cutouts used for bar pins, toys and novelties can be cut quickly and uniformly by using the strip or turned methods of cutting. In the turned method of cutting, the work is first turned as a ring, Fig. 1, using cardboard templates to check the shape. Then, the ring is sliced into individual cutouts on a circular saw, which is fitted with two blades separated by a spacing collar, as in Figs. 3 and 4. The jig for cutting consists of a sliding wooden table carrying a segment guide against which the ring is held. The strip method of cut-



ting can be used where the shape is not too intricate. Some work, such as the dog shown in Fig. 5, can be cut entirely on a circular saw; other figures must be worked on a shaper. Fig. 6 shows an example of a simple shaped figure, cut in eight passes of the work. Some grinding of specially shaped cutters is unavoidable, but a surprising amount of the contour often can be cut with cutters of standard shapes. Several test strips should be run in order to locate the exact position of each cutter in turn. Fig. 7 shows the figure fully shaped while Fig. 8 shows the simple second operation of cutting the strips to thickness. These methods can be used for either wood or plastic cutouts. Plastic strips should be sanded and buffed before slicing. Wood cutouts are shaped preferably across the grain so that the figures will show face grain after sawing.

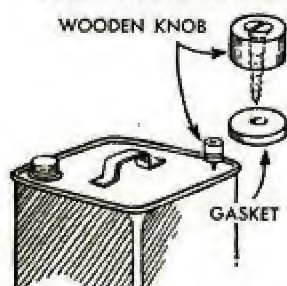
Produce Signs Hooked on Fence Are Changed Easily



One farmer who often advertised produce for sale at his home, used signs like the ones shown, which are hooked to the fence wires near his house. The hooks, which were nails driven part way into the board signs, made it easy to put up or take down the signs as required.

—A. H. Waychoff, Phoenix, Ariz.

Air Vent for Metal Container

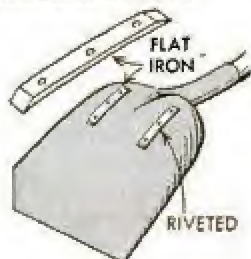


Instead of making a small hole in the top of a metal container to serve as a vent when pouring out the contents, make a simple screw-type vent like the one shown. It consists

of a wood screw driven through a small wooden knob for easy removal, and is driven down against a pliable gasket when sealed. There is no possibility of losing a vent of this type, and it takes only a twist of the wrist to seal a container or provide a vent.

Increasing Life of Scoop Shovel Used on Concrete Floor

A shovel used in a coal bin or other place where there is a concrete floor will soon be worn through by the abrasive action of the rough concrete unless the shovel

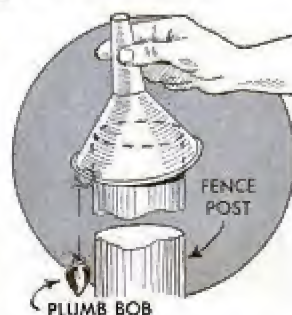


is thickened at the points of contact. A good way of increasing the thickness is to rivet two pieces of flat iron to the shovel as indicated. The ends of the two pieces should be beveled slightly and the rivet heads should be countersunk to prevent catching on the floor.

Funnel Suspends Plumb Bob For Setting Fence Posts

When setting or straightening fences, a funnel makes a good holder for the plumb bob sometimes used to aid in setting the posts vertically. With the plumb bob tied to its handle-loop, a

large funnel can be inverted over the end of the post to hold the plumb in position.



How to Keep a Laboratory Hose From Slipping Off Wall Hook



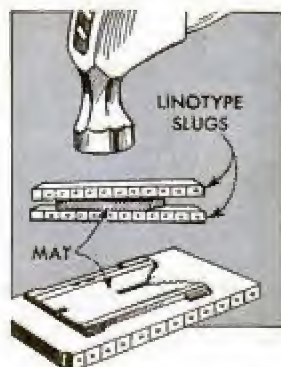
but still did not interfere with its removal when it was needed.

The tendency of a length of rubber hose to slide off the wall hook in a laboratory, led one instructor to drive a couple of glass picture nails into the wall below the hook as indicated. These held the hose in place on the hook,

Straightening Linotype Matrix

If you have ruined a linotype matrix by trying to straighten it with a hammer, try the following: Place the matrix between a couple of linotype slugs and then straighten it with a hammer. Being soft metal, the slugs

protect the matrix if the hammering is done lightly and very carefully. Naturally, this method is not recommended as regular practice, and should be used only in an emergency.





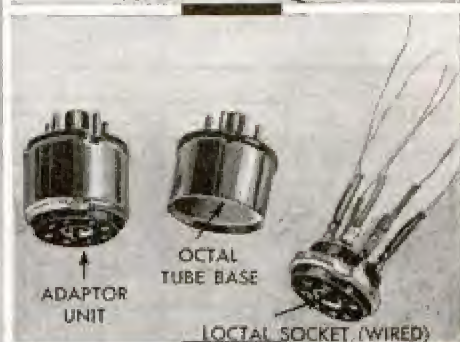
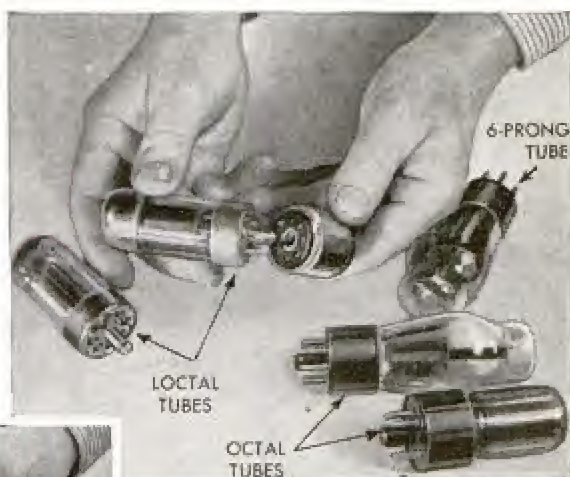
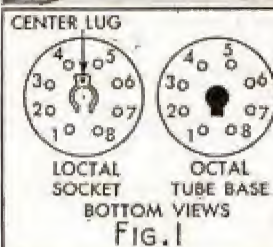
Wartime Tube Substitutions

By Robert Oelrich

ADAPTORS that any radio serviceman can assemble easily are now being used to combat tube shortages. These adaptors permit a radio tube of one base design to be used to replace a tube of equal electrical specifications of different base design. The substitute types are often available, but, without a suitable adaptor, the socket must be changed in the set itself.

No receiver wiring changes are necessary when using adaptors, except in a few unusual cases. They are very flexible; for example: a 5-prong tube may replace a 6-prong tube, or an 8-prong tube may replace a 6-prong tube, etc. The comparatively seldom used loctal-type tubes with specifications matching scarce types of octal tubes, are excellent substitutes when used with the adaptor illustrated.

To make this adaptor, clean an old octal (8-prong) tube base of all glass and cement and unsolder all old wire leads from the base pins. Clean the pins to allow the wires from the loctal socket to pass through. Cut wires, preferably No. 26 solid, 7 in. long, and insulate about 1 in. of each wire with "spaghetti" as shown in the photo of the wired socket in the adaptor assembly. The pin numbers are always designated in the manual charts with regard to the bottom view as detailed in Fig. 1. After soldering the wires in the pins following the chart data, cut off excessive wires and apply speaker cement to the edge of the socket and base. Charts Figs. 2, 3 and 4 are only a few of the practical wartime tube changeovers that can be worked out by radio servicemen and experimenters.



Substitute	To	Type
25Z5 (6 Prong)		25Z6GT (Octal)
Pin No. 1	2	
2	3	
3	4	
4	5	
5	6	
6	7	

Fig. 2

Substitute	To	Type
35A5 (Loctal)		35L6GT (Octal)
Pin No. 1	2	
2	3	
3	4	
6	5	
7	6	
8	7	

Fig. 3

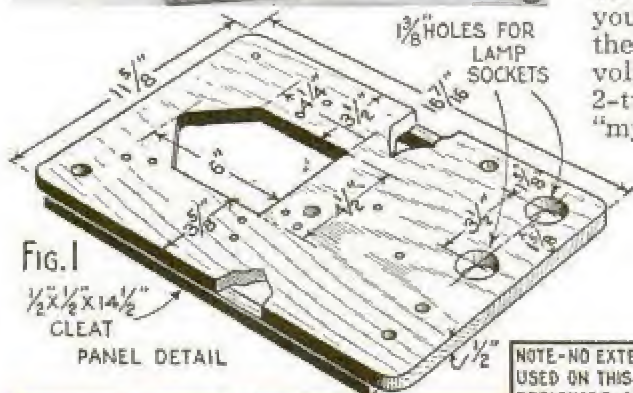
Substitute	To	Type
7Q7		6SA7
14Q7 (Loctal)		12SA7 (Octal)
Pin No. 1	2	
2	3	
3	4	
4	5	
5	6	
6	7	
7	8	
8	7	

Fig. 4

Note: Center lug on loctal to No. 1 on octal-Adaptor.

PORTABLE PHONO-ATTACHMENT

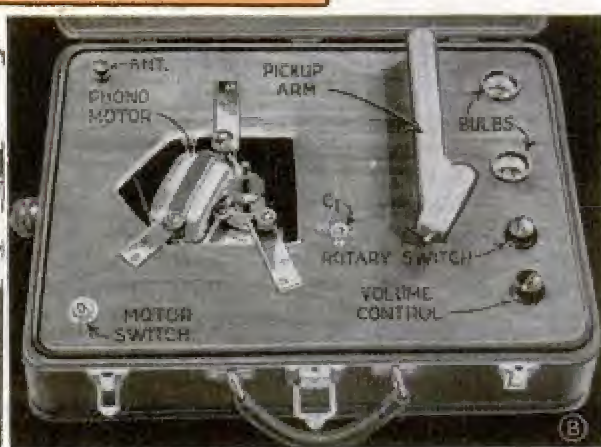
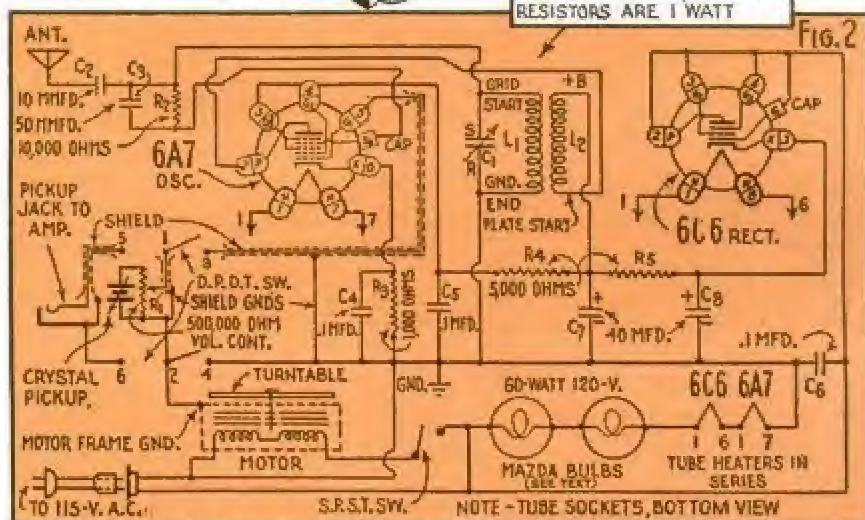
By Arthur I. Rattray



OPERATING through any radio receiver or amplifier, this portable combination a.c. unit provides high quality recorded music on short notice in friends' homes or in recreation centers. If a set with phono input jack is available, this unit can be connected directly by means of a short shielded lead with a phono plug on each end. When a radio receiver is to be used and there is no built-in phono jack, you merely insert two 60-watt lamps in the unit and these act as a line switch and voltage-dropping resistor to operate the 2-tube "wireless" phono oscillator, or "mystery" player so that records can be tuned in without wired connections.

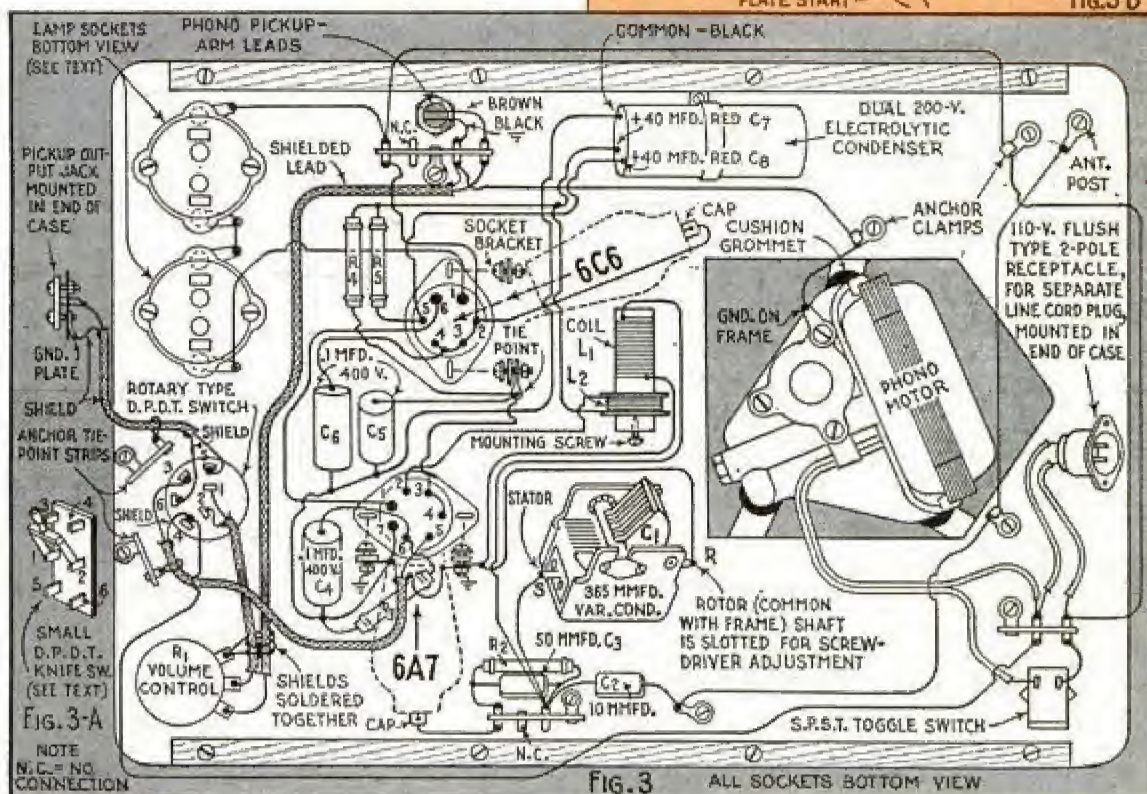
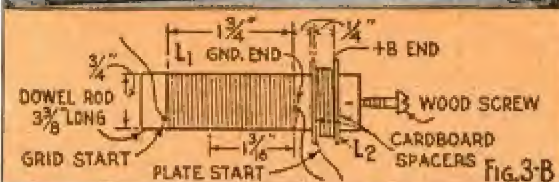
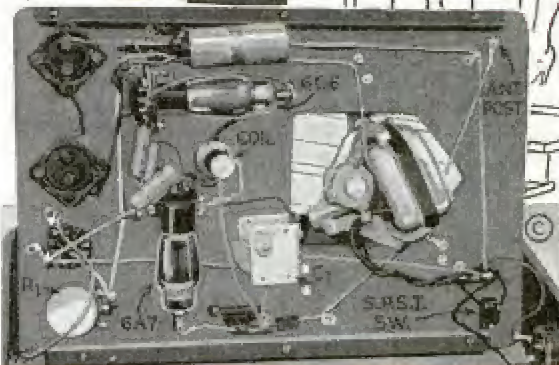
The oscillator portion of this unit was made from non-critical materials salvaged from a discarded midget receiver, and built around an old phono motor and turntable. The plywood

panel is detailed in Fig. 1. Any bag or sample case about 12 in. wide, 17 in. long and 4 in. deep will house the unit, provided that the lid is about 2 in. high so it will clear the pickup arm and control knobs. Fig. 2 shows the schematic circuit diagram and resistor values. Photos A, B and C and the simplified wiring diagram Fig. 3 show all parts in their relative po-

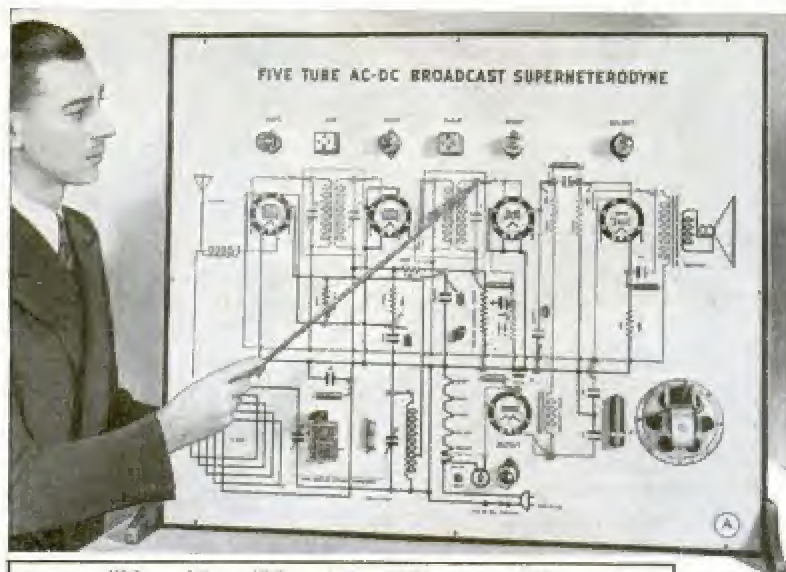


and "MYSTERY" PLAYER

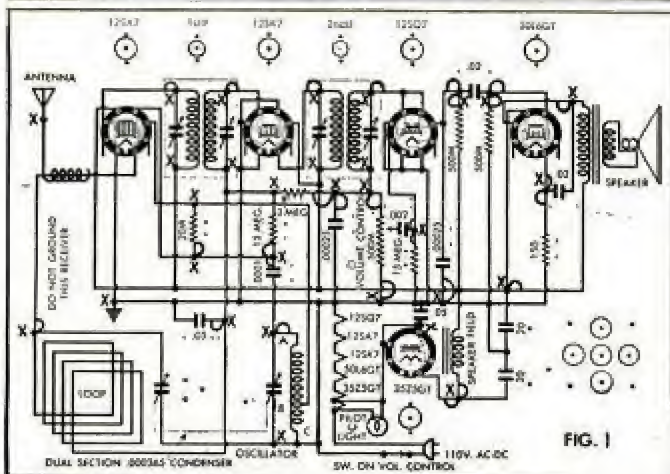
sitions. Condenser C_1 is mounted so that its slotted shaft extends through a hole in the panel for screwdriver tuning. The d.p.d.t. switch may be either the rotary type or the knife variety detailed in Fig. 3-A. Four 1-in. angle brackets support the rectifier and oscillator tube sockets. Oscillator coil, Fig. 3-B, is hand wound with No. 30 enameled wire obtained from a burned-out transformer, and tunes from 1,400 to 1,650 k.c. To make it tune where you wish in this range wind a full single layer of wire for $1\frac{3}{4}$ in. for L_1 ; if the coverage is too low in frequency remove a few turns at a time from the grid end of the coil, but not beyond the $1\frac{3}{16}$ in. section, until the desired portion of the receiver dial is covered. Plate winding L_2 consists of 130 turns random wound between two disks of waxed milk carton cardboard glued $\frac{1}{4}$ in. apart and spaced $\frac{1}{4}$ in. from the ground end of L_1 . Coil ends are anchored in tiny holes drilled through the dowel rod. Detailed material list R-323 is available from Popular Mechanics radio department, upon receipt of postage. If the unit does not oscillate, reverse plate winding leads L_2 . Turn the player volume control full on, and adjust volume with the radio receiver's volume control; pickup range is about 40 feet with a 10-ft. antenna. Reverse line plug in wall socket for lowest hum level.



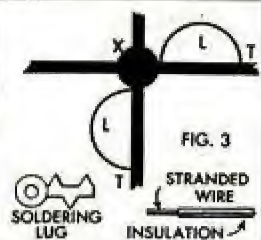
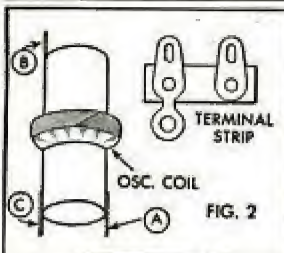
Flexible Five-Tube Demonstrator in Panel Form



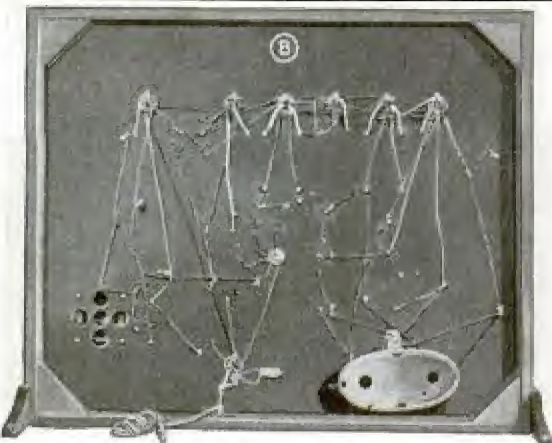
DESIGNED to simplify instruction in the theory of radio circuit design and operation, this flexible panel-type demonstrator unit is a complete 5-tube superheterodyne broadcast receiver. It is assembled on a 30 by 36-in. imprinted panel and mounted in a reinforced hardwood frame 3 in. deep. The unit may be hung on a wall or placed on a desk or bench in a vertical position. Two removable mounting feet provide the necessary support when used in this position as shown in photo A.



All parts except the loop are mounted in plain view adjacent to their schematic positions on the large diagram Fig. 1 which is printed in four colors on an off-white background. Grid circuits are in green, plate circuits are in blue, positive potential (B plus) leads are in red, and the balance of the circuit is in black in accordance with RMA standards. Multiple snap connectors are used on studs at points marked X on each tube element for signal and voltage measurement, also at circuit junctions so that each coil, condenser or resistor may be opened



or, where it will not damage the unit, shorted out to simulate actual conditions in defective receivers. This feature provides an excellent means for demonstrating trouble shooting and the proper use of test equipment in teaching repair work. All trimmers are easily accessible from the front of the panel for demonstration of alignment procedure.



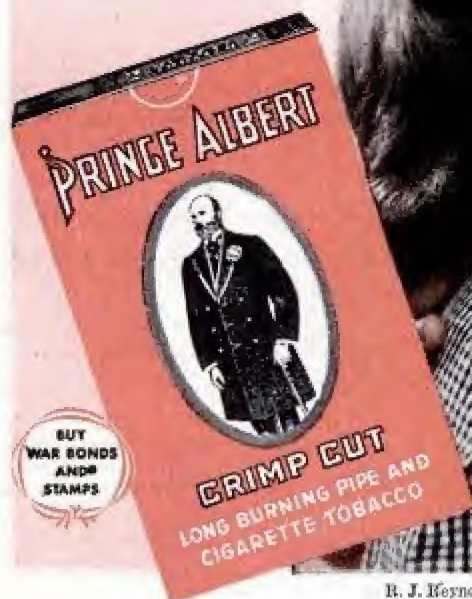
Available to all schools and other institutions conducting educational programs, it comes with drilled panel in kit form or completely assembled and wired. Mounting and wiring details for the oscillator coil and multiple snap connectors appear in Figs. 2 and 3. Photo B shows all wiring back of the panel; the loop antenna is at lower right, and the holes that form the speaker grill appear at the left. Surprisingly good results are obtained with the small speaker due to the baffle effect of the large panel. The tubes are of the high voltage filament type and the circuit is for 110-volt a.c.-d.c. operation.

PIPE APPEAL*

WATCH IT WORK!

He—What's the big occasion, my love?

She—YOU, darling!



B. J. Reynolds Tobacco Company, Winston-Salem, N. C.

WHEN you see a woman retire...from the pipe she used to admire...get busy, brother...get Prince Albert in your bowl. Watch P. A.'s PIPE APPEAL—its *so-soothing* aroma—change hisses to kisses—fretting to petting. And see how P. A. peps up your personal pipe-joy. It's prize tobacco—no-bite treated—richer-tasting, yet SO MILD. Crimp cut...draws easy, packs right. World's largest seller—first puff tells you why.

50 pipefuls of fragrant tobacco in every handy pocket package of Prince Albert

70 fine roll-your-own cigarettes in every handypocket package of Prince Albert

TURN TO
TONGUE-EASE—
P.A.'S Milder.
RICH TASTE THAT'S
MELLOW



* **PRINCE ALBERT**
THE NATIONAL JOY SMOKE

WHY THE ELASTIC COLLAR?



ONE REASON YOU CAN'T BUY THEM NOW

This is the drive cog of a tank. It yanks the tread with as much as 1,000 horsepower. That, together with rough going, gives tank treads an awful beating. So, for security, they are fastened with Elastic Stop Nuts. The cog and each lug you see in the picture are held on with Elastic Stop Nuts.



You see here an Elastic Stop Nut.

The thing that makes it different from other nuts is the special collar in the top.

This collar is made of an elastic material.

It presses itself between the bolt threads. It grips and holds tight. The nut cannot turn by itself.

This means the nut locks anywhere on the bolt and won't work loose.

Even violent vibration won't budge it.

You can put an Elastic Stop Nut on and take it off, time and time again. It always locks.

That's because the collar is elastic. It does its job and comes back for more.

Many billions of Elastic Stop Nuts are in use.

And to our knowledge, not one in a million has ever failed.

When peace comes, Elastic Stop Nuts will be available for all the good things to come. They will make them safer, stronger, more dependable and free from frequent servicing. So expect to see many of these nuts you can identify by ESNA'S red collar.

ESNA
TRADE MARK OF

ELASTIC STOP NUT CORPORATION OF AMERICA

ELASTIC STOP NUTS

Lock fast to make things last

Union, New Jersey and Lincoln, Nebraska

AFTER THE WAR IS OVER...



AT fighting fronts or on production fronts — the desire for motorcycling thrills still lingers. And whether fellows wear campaign ribbons or Army-Navy "E" pins, their day dreams run about like this letter:

"In 1935 I bought my first '74' which I rode 5 years and turned over a good many miles of the best fun I ever had. After the war is over I've planned a trip that will take me over every state in the Union and will fulfill all my old dreams of a real outdoor trip!"

You bet! The days of long trips, race meets, hill-climbs and all other fun-packed motorcycling events will come again! Plan to be riding with the rest of the gang on a brand new Harley-Davidson — so Buy War Bonds NOW!

*Write for free copy of ENTHUSIAST MAGAZINE,
filled with motorcycle pictures and stories.*

HARLEY-DAVIDSON MOTOR CO.

Department PM, Milwaukee 1, Wisconsin

HARLEY- DAVIDSON MOTORCYCLES

HARLEY-DAVIDSON MOTOR CO.
Department PM, Milwaukee 1, Wisconsin

Please send at once free copy of 24-page
"Enthusiast" Magazine, filled with motor-
cycle action pictures and thrilling stories.

Name _____
Address _____
City _____ State _____



**SEND COUPON
NOW**

FREE!

Contrary to popular belief, today's slow driving dirties spark plugs quicker. Regular cleaning and adjustment are more necessary. When you need new plugs, get the longer life that is engineered into AC Spark Plugs.



BUY ANOTHER WAR BOND THIS MONTH

The Camera Clicks for Uncle Sam

(Continued from page 38)

training and entertaining service men, probing the mysteries of explosives and projectiles, telling the grim story of the war at the fronts, surveying crops, protecting valuable records on microfilm, turning out millions of blueprints, and doing thousands of other odd jobs.

Photographs are even being used to sell furniture. Because of the shortage in transportation, the shipping of new models to some furniture shows has proved impractical. Instead, the pieces are artistically shot with the camera from all angles, the photos placed on display at furniture expositions and orders taken.

Probably the biggest single photographic project undertaken since the invention of the little black box with the lens is the snapping of portraits for identification badges and cards to be worn and carried by millions of American workers. Automatic focusing and quick developing and printing methods made this a quick job.

The portrait may bring wise cracks, but each worker accepts it as a badge of membership in the industrial army.

Flak, Unlimited

(Continued from page 80)

tively than that. Their motto runs: "If you hit him in the rudder, you only make him shudder; if you hit him in the prop, you always make him drop."

Hitting a fast airplane target is not as easy as you might think. It's about as hard as using a pea shooter to knock down a bumblebee across the street. At the beginning of his training a young gunner may be certain that he has chewed to bits a practice target towed by an airplane. But when he looks at the target after the plane drops it he may not find a single hole. Practice and lots of it as a team is what makes the individual gunner and the whole crew good marksmen. The men have to learn the idiosyncrasies of their weapons and to compensate for them.

Each gun crew gets plenty of instruction before it sees active combat. The men fire, both night and day, at sleeve targets that are towed at various altitudes. They learn to whip their guns around in a hurry and then steady them as they begin to lead the target. They fire bursts at radio-controlled miniature airplanes that are in effect scale models of full-sized aircraft flying at higher altitudes, and they fire at rocket targets that whiz past them overhead at speeds of up to 400 miles per hour.

The lamp that paints a bullseye on Axis planes!

1. Ever wonder how our gunners can fire accurately at 400 m. p. h.? One reason is a new kind of gunsight. Instead of straining to hold the enemy in your sights as you would with a rifle, you see a "bullseye" of orange light ... apparently painted right on the enemy plane! Diagram below shows how it works.



2. The problem G-E had was to develop a new lamp for greatly increased brightness. Combat experience showed that the image had to be bright enough to show up against Sahara sands or bright clouds. Gunsights now are being equipped with a lamp G-E developed especially to meet these conditions.



3. To design and produce this new lamp in a hurry was a tough problem...but no tougher than many which G-E research has had to solve since Edison's first lamp. Between the big 10,000-watt airport floodlight and the tiny "grain-of-wheat" lamp used for instrument illumination are hundreds of different G-E lamps working for victory.

4. The same research that produces G-E lamps used in war is your assurance that the G-E lamps you use will give you the most light for your money.

Hear the General Electric radio programs: "The G-E All-Girl Orchestra," Sunday 10 p. m. EWT, NBC; "The World Today" news every weekday, 6:45 p. m. EWT, CBS.

**MADE TO
STAY BRIGHTER
LONGER**



G-E MAZDA LAMPS

GENERAL  ELECTRIC

THE BEST INVESTMENT IN THE WORLD IS IN THIS COUNTRY'S FUTURE...BUY WAR BONDS



CRACKED WALLS

You don't have to be an expert to mend cracked walls with Rutland Patching Plaster. Just mix Rutland with water . . . wet the old plaster . . . and apply with knife or trowel. Rutland is the *original* ready-to-use patching plaster. Sets without shrinking or cracking. Extra fine and white. Makes a patch as smooth and lasting as the wall itself.



BROKEN CONCRETE

Don't let small breaks in cement floors, walks, walls, etc., get larger. Mend them promptly with Rutland Concrete Patcher. Just mix with water and apply with trowel.

RUTLAND

REPAIR PRODUCTS

Rutland Fire Clay Company, Rutland, Vt.

More Power for the Farmer

(Continued from page 54)

into a single-unit machine by means of ingenious linkage and hydraulic control of the implement. Instead of being merely dragged by the tractor, the implement becomes virtually a part of it.

Ferguson attachments make it possible to plow, cultivate, ridge; to aerate and prepare stubble land, haul a six-ton trailer, haul and operate a cross-cut saw—and an almost endless variety of other tasks. Standard tractor mowers, horse-drawn disc harrows, seed drills, combines, manure-spreaders and other wheeled implements can also readily be attached to the tractor. Chief benefit of the regular attachments, however, is that they can all be raised from the ground into carrying position by means of a hydraulic control located at the driver's hand.

"That the most basic industry of all has not heretofore been able to adopt the principles of mechanization which have made other industries prosperous is a challenge to everyone," says Harry Ferguson, who with Henry Ford has vowed to cut the cost of farming so that the farmer will make more without needing to raise his prices to the consumer.

They want to make farming attractive to youth, and start a new back-to-the-farm movement—and how vital this is is shown by these figures:

In three years, 1,200,000 young farm men turned in their blue jeans for uniforms.

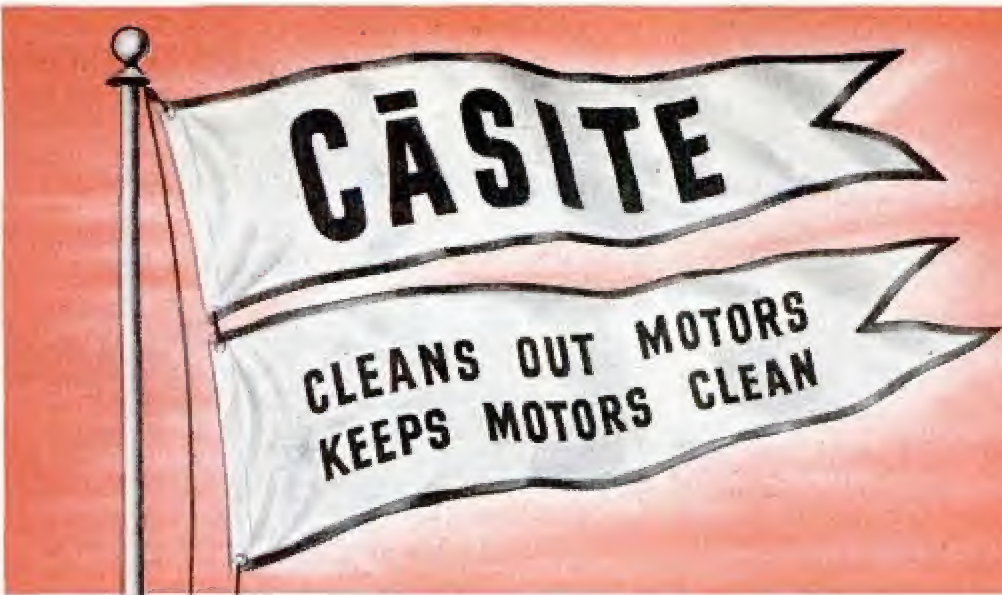
Another 1,400,000 adults left the farms for war jobs in cities.

Still another 1,700,000 farm people, though not leaving the farms, abandoned tilling the soil in favor of jobs in nearby war plants, or other nonfarming pursuits.

"Unless we are successful in getting these young people back to farms where they will help nature create the basic wealth of this country we can well be concerned about our future stability," says a Ferguson spokesman.

It is this same challenge that is faced by Mr. McCaffrey of International Harvester:

"It used to be said that the effect of the mechanization of agriculture inevitably would be to increase the size of the individual farm and reduce the number of farmers. Actually, for the last 10 years the most striking development in our industry has been the rapid appearance of machines suitable for the smaller farms. We are certain that trend will continue, and we know that it is a healthy one. Only by doing that will the farms remain a great mass market for the products of American industry."



CASITE

CLEANS OUT MOTORS
KEEPS MOTORS CLEAN

● A dirty motor starts hard—jerks, sputters and wastes gasoline. With Casite in your crankcase your motor stays clean, runs smoothly, starts readily . . . you get longer motor life, added driving satisfaction, better gasoline mileage.

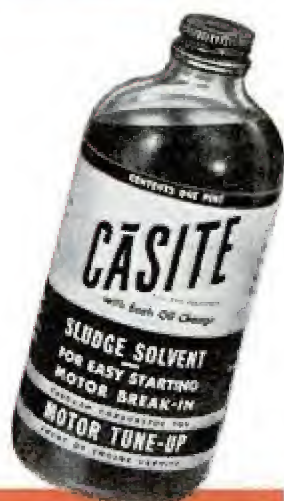
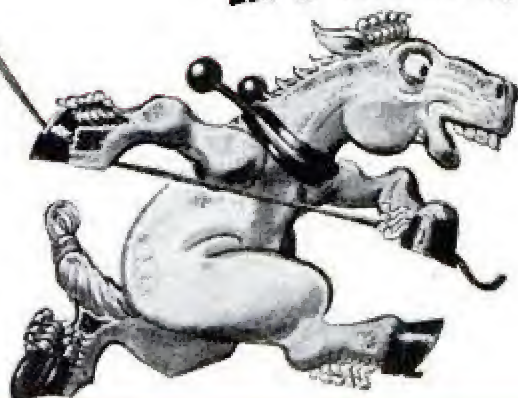
Casite is sold coast-to-coast by service stations, garages, and car dealers. The price is only 65¢ a pint. Start today cleaning out your motor, and keeping it clean . . . with Casite.

THE CASITE CORPORATION • HASTINGS, MICHIGAN

A pint through the carburetor at regular intervals . . .

a pint in the crankcase with each oil change.

LET'S GET GOIN'!



★ IT'S A PRIVILEGE TO BUY WAR BONDS ★



WILD TURKEY

"Here in West Virginia where we still hunt the native wild turkey, the terrain is rough and rugged, and our chances at game are often taken from one hill to another.

"My fondest recollections date back more than thirty years to the time I first came into possession of a Marlin rifle—a 32-20. Then followed a 25-20, a 30-30, and a Marlin lever action 22.

"All the Marlins I have owned were super accurate, efficient and trustworthy."

Thos. E. Knapp, Alderson,
West Virginia

★ ★ ★

Marlin thanks Mr. Knapp and the thousands of other sportsmen who have expressed appreciation for the accuracy and dependability of Marlin Guns. We are concentrating on war production until the war is won. After victory, however, Marlin will introduce new models and many improvements in its well-known line of rifles and shotguns.

THE
Marlin
FIREARMS CO., NEW HAVEN, U.S.A.

No. 1 Enemy on the Home Front

(Continued from page 87)

H. L. Miner, manager of the Du Pont Company's Safety and Fire Protection Division. Paper, cloth and wood are among the materials that now can be chemically treated to make them incapable of spreading flames. Lumber is being treated chemically until its fire-retardant quality is closer to that of asbestos than to ordinary wood.

Chromated zinc chloride is deposited in the wood under pressure, in chambers big enough to accommodate long trains of narrow-gage cars. Practically all kinds of cloth, also, including the sheerest, can be treated so that you can't burn it.

Still, Mr. Miner, like other fire authorities, emphasizes that every advance of science might as well have remained an idle dream, if personal carelessness is the order of the day. The best fire-fighting, and fire-preventing equipment in the world can't approach man's own caution. Educational campaigns are of first importance. In many war plants, for instance, new employees are not likely to know either where the alarms are, or how to set them off; much less will they know how to use emergency fire equipment, unless they are shown.

First lesson should be that, if all precautions fail and fire does take hold, the No. 1 thing to do is—not to grab the extinguisher—but to grab the telephone, or otherwise summon the professional firemen. Then grab the extinguisher. In one plant, for instance, well-meaning employees tried to fight a blaze for 20 minutes without once thinking of calling in the firemen. When they finally did, the flames were so out of control that what might have been a little flare-up caused \$400,000 damage.

In case of fire, call the firemen; learn how to turn in an alarm; learn also how to handle whatever emergency equipment is at hand. But above all, learn safety; keep fire from happening.

They Bring Themselves Back Alive

(Continued from page 61)

ing on the average Pacific island. Any volcanic isle or coral atoll furnishes fowl, fish and one or more fruit or vegetable like coconuts, pigweed, bananas, sugar cane, mangroves, limes, guavas, papaya and even oranges. The coconut tree not only furnishes food and drink but clothing, baskets, mosquito netting, cloth, rope, bedding, sandals, sunburn lotion, shingles, torches, and even beer, if you know how to use the materials.

(Continued to page 154)

Scourge of the Wolf-Pack!

FROM the blue waters of the Caribbean to the icy depths of the North Atlantic, Nazi U-boat packs are on the run. Speedy, hard-hitting Navy Destroyer-Escort ships, quantity-built in several American shipyards, have done their part to clear the convoy lanes of enemy submarines.

The men and women of Defoe—workers and management alike—are proud to be constantly ahead of schedule in the production of these famous DE fighting ships. The unique "roll-over" construction process has made this record possible.

Due to these accomplishments, the Navy now has called upon Defoe's engineering and production facilities to build fleets of LCI (L) Landing Craft. These large armor-sheathed ocean-going invasion vessels are today proving a potent force in the march to Tokyo and Berlin.

When Victory is won, the experience, skill and spirit of Defoe men and women—now devoted solely to helping meet the needs of the Navy—will be at the disposal of industry to provide products of better quality, greater value and lower cost for peacetime America.

BACK THE ATTACK—BUY WAR BONDS. Defoe workers take more than 10% of their pay in War Bonds



DEFOE SHIPBUILDING COMPANY,

BAY CITY, MICHIGAN

Defoe



Three White Star Renewal Citations now decorate the Navy "E" Award won by Defoe workers.

**Ships for Victory
Servants for Peace**

Tool Tips by **STANLEY**

VERTICAL CHISELING

Knowing how to use the wood chisel can save you many a piece of rare wood, and hours of lost time. Here is a point to remember:

In cutting vertically, across the grain, the chisel should be tilted slightly to one side to give it a shearing, or slicing, ac-



tion. If the surface is wider than the chisel, press part of the chisel against the portion just cut using it as a guide to cut the next portion.

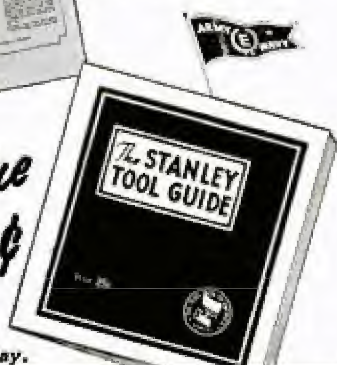
Tools are Vital to Victory ... Make them last



For complete information (with sketches) on vertical chiseling and dozens of other operations get a copy of the "Tool Guide". It's a must for every workshop.

**A Big Value
for only 25¢**

Write for your copy today.



STANLEY TOOLS

DIVISION OF THE STANLEY WORKS
105 ELM STREET

New Britain, Conn.

One of the first things to learn in the tropics is the art of camouflaging by the use of twigs, branches, leaves, mud, paint, vegetable dyes or whatever else the jungle affords locally. Success depends on ingenuity. Few Americans, however clever, equal natives at the art of concealment as one hungry, stranded aviator found out when he hurried up to a banana tree on a Pacific island, reached up for a tempting piece of fruit only to have the tree walk off into the jungle before he realized it was a camouflaged native who had been watching him all the time.

The Tube That Is Remaking the World

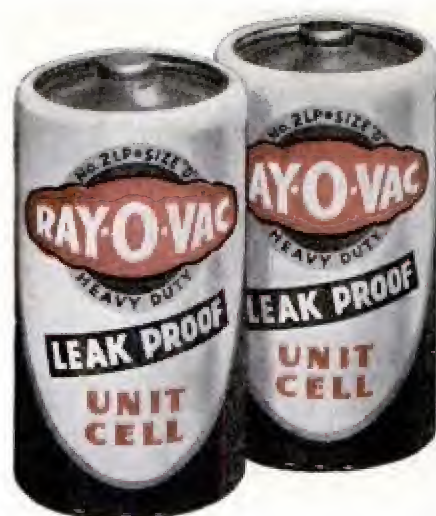
(Continued from page 25)

engineer employs the mass spectrometer to dissect a complicated gas molecule $1/25,000,000$ th of an inch long and automatically record the composition of the gas, mightily accelerating the analysis of gases in the production of butadiene synthetic rubber. Five to ten skilled chemists used to spend 15 hours to 3 days analyzing a cubic foot of gas. The electronic spectrometer weighs out the molecules and atoms of a thimbleful in just 15 minutes, and without error.

More sensitive than man? The human eye can detect 10,000 tints, the photoelectric spectrophotometer 2,000,000. It can discern one part of silver in a solution 250,000,000 times the volume of the silver. In a millionth of a second the X-ray can spot a flaw in the heart of inch-thick armor steel. A mercury vapor detector in a General Electric plant "smells" one part of mercury in 200 million parts of air. An electronic tuning fork "feels" the change of pace if a turbine steps up momentarily from 1,800 to 1,800.1 revolutions per minute. The electron microscope, window to a new world, makes visible particles as small as a millionth of an inch—the human hair divided into one-thousandth. The electronic tube is the eye and ear of television, and in the postwar world television "light-houses"—automatic relay stations—will bring you in full natural color the scenes and sounds occurring around the world.

War shrouds in secrecy many of the electronic wonders evolving in the research laboratories today. The wonders of radar, seeing the unseen bomber plane and battleship and submarine periscope. The wonders of the cyclotron, prying into the heart of the atom, and of the 100-million-volt X-ray machine already at work in a Gen-

(Continued to page 156)



Actual photo of
LEAKPROOF
BATTERIES
picked at random
from 1939
manufacture.

THESE FLASHLIGHT BATTERIES ARE **4 YEARS OLD - and STILL FRESH**

Remember when you picked up a flashlight, long unused, and found the batteries dead? The fact is, most flashlight batteries die just lying around...but not Ray-O-Vac LEAKPROOF Batteries. LEAKPROOF'S patented sealed-in-steel construction seals the power in...it's there when it's needed!

RAY-O-VAC LEAKPROOF BATTERIES ARE.
NOW GOING 100% TO OUR ARMED FORCES



FLASHLIGHTS • BATTERIES

BUY WAR BONDS



BUY WAR STAMPS

RAY-O-VAC COMPANY, MADISON 4, WISCONSIN
OTHER FACTORIES AT CLINTON, MASSACHUSETTS • LANCASTER, OHIO • SIOUX CITY, IOWA

How to

**MAKE
HAND SAWS
LAST LONGER**

See Your Hardware Dealer!



Tools are mighty important to the war effort. Your Hardware Dealer is cooperating with Uncle Sam by selling some types *for essential uses only.*

Perhaps you may not be able to purchase a new hand saw. Nevertheless, your Hardware Dealer *can* help.

If your old saw is a Disston—or other quality make—a good, inexpensive reconditioning job will put it in serviceable condition. See the Disston dealer in your community. Talk it over with him. At the same time he will tell you about the possibility of getting new tools for essential work.

Save your tools and serve your country. Fix 'em up and make 'em do!



HENRY DISSTON & SONS, INC.
411 Tacony, Philadelphia 35, Pa., U. S. A.



GOOD ADVICE AND PRACTICAL HELP
on tool use and care are yours for the asking in the Disston Saw, Tool and File Manual. FREE from your Hardware Dealer, or write for a copy.

eral Electric laboratory. Of electronic detectors locating buried mines or probing wounds for shrapnel fragments, radio transmitters in reconnaissance planes sending facsimile maps with the speed of light to an army base 100 miles away, electronic crewmen in our warplanes sensing ice formation on wing tips and warning of overheating engines, piloting bombers on unerring, level courses with superhuman accuracy as they make their target run.

After the war there will be time for staticless radio and true-color television, for short-wave chats between automobile and home, for flying and ocean travel made safe by electronics, for homes made light and radiantly warm and germ-free and for work made easy by vacuum tubes, time then for wresting the power from the atom.

Charles E. Wilson, executive vice chairman of the War Production Board, calls electronics "the fire of the future."

"Like fire," says Mr. Wilson, "it can be a savage foe or a powerful servant. Like fire, it is almost universal in its potential applications to our lives. Fire was a gift to the barbarians, which men have shaped to their uses. Electronics has been no gift. The men of science learned its secrets and earned its blessing during decades of unremitting toil, patience, trial and error, and brain work. . . The electronic tube, so innocent and so mysterious to a layman's eyes, will touch you, in the years to come, wherever and however you live—your sight, hearing and taste, the food you eat, the healing of your body, the safety of your home, and the tremendous progress of your business, whatever it may be."

Tenderfoot Skipper

(Continued from page 31)

many details of coming into port. We were all very pleased with ourselves that night. We had completed our first long trip safely, and even if we were disappointed not to have made contact with a sub on the way, we had made landfall "right on the nose."

The next few days were busy. Then one night a messenger came with "secret" orders. We were to be the guinea pig of an experiment. My ship was to tail a convoy and sneak into an attack position at night. Then we were to be fired on as if we were a sub. Careful plans were made so that we shouldn't be hit, but—it still made us nervous to think that a lot of guys with itchy trigger fingers were going to point a lot of guns in our direction.

A day or so later we "shoved off" and after tailing the convoy all day started to

(Continued to page 158)

Here's how your car **FEELS...**



...after

MARFAK


chassis

lubrication!

Car stiff in the joints? Hard to handle? A rattle here, a squeak there? Give it new riding comfort and driving ease with tough, long-wearing MARFAK chassis lubricant. Always applied by chart, never by chance. From king pins to rear shackles every point of lubrication is shown on the chart and the proper type of lubricant is plainly listed. And with each job your Texaco Dealer checks every point of wear, every point of adjustment, sends your car forth hale and hearty. Ask him to give your car that "MARFAK feeling"—tomorrow!



For Your Enjoyment... 2 Great Radio Programs

 **FRED ALLEN:** Every Sunday night. See your local newspaper for time and station.

METROPOLITAN OPERA: Complete broadcasts of great operas every Saturday afternoon. See your local newspaper for time and station.



Take the Br-r-r out of breakfast



KEEP WARMER WITH BALSAM-WOOL ATTIC INSULATION



A warmer house in the morning . . . more comfort all day long . . . that's what you get when you apply Balsam-Wool Insulation in your attic! And, while making your home more livable, Balsam-Wool actually saves fuel—as much as 20%, many householders find.

Easy to apply—laid like a carpet in your attic, Balsam-Wool is the original blanket insulation—windproof, moistureproof and fire resistant. It is sold under a money-back guarantee of complete satisfaction. Don't wait—see your lumber dealer now. Ask him about his monthly payment plan—or mail coupon for complete information.

Balsam-Wool

SEALED ATTIC INSULATION

Balsam-Wool . . . Products of Weyerhaeuser . . . Nu-Wood

WOOD CONVERSION COMPANY
Dept. 210-4, First National Bank Bldg.
St. Paul 1, Minnesota

Gentlemen: I want to know more about Balsam-Wool Double-Value Attic Insulation.

To assist us in giving you special information, please check: I am a home owner ☐
renter ☐ architect ☐ contractor ☐
student ☐

Name.....

Address.....

City.....State.....



close in about sunset. Before we were on station, darkness fell. Never have I experienced the blackness of that night. As the zero hour neared I couldn't be sure where the convoy was. I hated to think what would happen if our ship was in the wrong place. Purely by "feel" we edged into position. I had sent all the men below except those necessary to run the ship. Those left "topside" were ordered to wear helmets and not expose themselves more than necessary. When zero hour arrived hell broke loose from the convoy. Shell fragments fell all about the ship, a few hitting the deck aft. We crouched on the flying bridge expecting momentarily that some guy would miscue and land one right on us. I guess those boys knew what they were doing for soon the firing ceased. From what was learned that night, I'm sure our convoys have been a bit safer on the seas.

At daybreak we received an order from the escort commander to relieve a PC having trouble with its sound gear. Around the convoy we steamed and drew up alongside the ship we were to relieve. They passed us a line and transferred their orders to us. We were on our first convoy.

Our first excitement in escorting convoys came months later when our sound operator called out in an excited voice: "CONTACT—bearing zero seven-five." I grabbed my glasses and pulled the general alarm. Men rushed to their stations as the siren wailed. The sub, if it was a sub, was only 600 yards away, and moving slowly toward the convoy. That wasn't going to give us much time to make a good attack. Knowing this was a vital convoy, troops for Africa and high-octane gasoline bound for Russia, I decided to make an "urgent" attack. In we went toward the sub at full speed. The team was clicking perfectly. The sound operator called out his bearings, the sound officer calmly called out the ranges and what little indications he could of our relative speeds. Then . . . "FIRE ONE" and a series of orders to the men on the fantail. Suddenly the sea astern exploded like a volcano and smacked the bottom of our ship.

No sub came popping to the surface, and we tried frantically to regain contact on our sound gear. We were disappointed but all felt better that we had at last made an attack. A few days later another convoy lost a couple of ships at that approximate position. We felt we had kept a sub from getting one of our ships.

It's hard to fight an enemy you never see—like fighting a ghost—but after this war is won the tenderfoot sailors on the sub-busters can hold up their heads in pride.



INDIAN
TRAIL BLAZERS



Which Way Adventure

Take the right fork... or the left... there's fun, fellowship and the greatest sport in the world just waiting for you when you own an Indian, America's most famous motorcycle. With an Indian, you'll enjoy a thrilling new freedom... away from plodding traffic lanes. You'll be able to explore those out of the way places no car can ever get to. On smooth highways or country roads... you'll find that your Indian ride will be incredibly smooth. You'll experience a feeling of safety and confidence you never believed possible. Make your plans now

so that when this war is won, you can enjoy motorcycling at its finest, astride an Indian.

INDIANS ON THE WARPATH

Right now, all new Indian Motorcycles go straight to war, and what a fighting record they're turning in! But new, improved, postwar Indians are already being blueprinted. *They're the motorcycles to wait for!*



**BUY WAR BONDS NOW
TO BUY AN INDIAN LATER**

Indian Motorcycle Company
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Mail FREE copy of exciting Indian News.

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PM-4

Indian

MOTORCYCLES

Keeping 'em Flying

WITH CHAMPION SPARK PLUGS

The men who literally "keep 'em flying," the ground crew mechanics of the Army, Navy, Marine and Coast Guard Air Forces, are daily performing prodigies of maintenance, service and repairs. These unsung heroes, schooled and skilled in many crafts, keep their charges airworthy and in fighting trim at all times.

One of the first things the ground crew mechanics check is spark plugs, because they know how vital they are to the engine's performance and dependability. Outstanding performance and dependability are the principal characteristics of Champion Ceramic Aircraft Spark Plugs—qualities which have won for them an ever increasing demand from our Air Forces.

These same qualities are inherent in all Champion Spark Plugs, including those for your car. In fact, the Champions for your car are products of the same research and engineering, and many of their basic materials and patented features are embodied in Champion aircraft types.

Have your spark plugs tested and cleaned at regular intervals. This is vital to the times and will assure you of maximum economy and dependability.



CHAMPION SPARK PLUGS



"... Let Freedom Ring" BUY WAR BONDS

Say you saw it in Popular Mechanics!

New Magic in Black Gold


(Continued from page 75)

Research found a way to release oil that was imprisoned in rock formations, by sending acid down the well to dissolve the rock. Then the men turned around and found a way of creating rock instead of dissolving it, for a different purpose. You might call the result a super concrete. It comes in handy when a well that is being drilled encounters a flow of water. Rock-forming material is dumped down the well to harden and seal off the water, then the drill cuts a hole through the artificial plug and drilling continues.

The petroleum scientists have built up a giant industry based on the chemistry of crude oil and gases. Petroleum's multitudinous products have become part of our lives in more ways than might be dreamed. A woman at her dressing table and an American bomber over Berlin might seem to have nothing in common but each is dependent on petroleum in many disguises.

Petroleum products went into the cosmetics the woman uses, her soap, the lacquer on her dressing table contained a solvent synthesized from petroleum products. Her clothes were made with the aid of petroleum, and even her rubber heels, her plastic comb, and her shampoo.

Without petroleum we would be desperately in need of substitutes for building airplanes. Camouflage paint has a petroleum base, cloth control surfaces are coated with a petroleum substance, bomb bay doors are of a petroleum plastic, self-sealing fuel tanks and lines are of synthetic rubber derived from petroleum, and the liquid in the hydraulic system is a petroleum product. The bombardier sights through a window made from petroleum and drops bombs that depend for their explosive force on toluol from petroleum. The list is longer than that, even without considering the petroleum fuel and lubricants.



Model Builders Attention!

	V	V-2	V-3
Hex	1/8"	3/16"	5/16"
Thread	3/8"-24	1/4"-32	1/4"-32
Thread Length	7/32	7/32	5/32
Weight, Grams	8	3 1/2	2 1/2

Actual Size V-Plug

Champion spark plugs for model gas engines give the same dependable performance as their larger counterparts. Sillment sealed. Sillimanite insulator. Alloy needlepoint electrodes for easy starting. One-piece construction.

CHAMPION

SPARK PLUG COMPANY

TOLEDO, OHIO

Ingenious New Technical Methods

Presented in the hope that they will
prove interesting and useful to you.



New Saw-Gun Saws and Files in Hard-to-Get-At Places

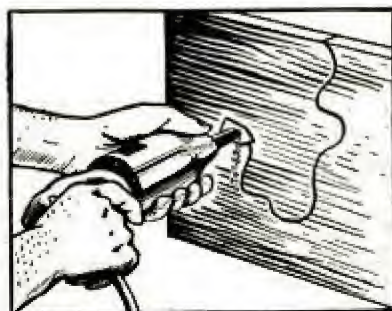
Jobs of sawing and cutting that are inaccessible to ordinary tools, are now made possible with the recently developed Saw-Gun. It works equally well on wood, plastics, light and heavy gauge metals (corrugated or plain—stainless and monel), castings, rods and other materials. The Saw-Gun saves hours on panel notching and slotting operations, doing work ordinarily requiring the use of several tools.

It is propelled by electric power, compressed air or flexible shaft and provides an efficient portable power-saw or file, that can be carried from place to place.

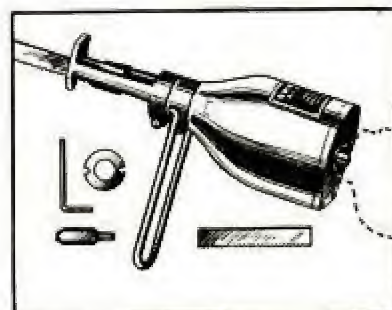
The Saw-Gun is operated by placing cutting edge of saw blade against work and turning on power. Filing is accomplished in the same manner by inserting a file in the tool instead of a saw blade.

We hope this has proved interesting and useful to you, just as Wrigley's Spearmint Gum is proving useful to millions of people (much to their surprise) working everywhere for Victory.

*You can get complete information from the Mid-States
Equipment Co., 2429 S. Michigan Ave., Chicago 16, Ill.*



Permits sawing and filing in spots
inaccessible to ordinary tools.



Can be directly connected to electric
drill, air drill, or flexible shaft.

Y-108

'INVISIBLE' LIQUID

proves great success for

SKIN and SCALP IRRITATIONS

**Promptly
Relieves
Itching—
Aids
Healing!**



Here's a Doctor's formula—Zemo—a remarkable liquid which appears invisible on your skin—yet so highly medicated that first applications relieve itching, burning of Eczema, Psoriasis, and similar skin and scalp irritations due to external cause. Zemo also aids healing.

Zemo positively won't show on skin all the time it is helping it. Apply any time. First trial convinces! 3 sizes. Buy Extra Strength Zemo for stubborn cases.

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NEW 6 INCH PLASTIC SLIDE RULE

Lightweight, Laminated PLASTIC

7 ADDED FEATURES

Plastic, cannot warp or break, stays accurate, engine-turned calibrations can't rub off; handy size with all scales to figure any arithmetic, multiplication, division, geometry, engineering problems; 1000 other uses. Has 6" and metric rule conversion tables for decimals, fractions, weights—quantity, liquids, BTU, HP, arcs, linear-metric, etc.

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Includes "Easy-to-Use" INSTRUCTIONS

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Or send Money Order or ACADEMIC SLIDE RULE CO. Cash, and we pay postage. CARROLL, OHIO DEPT. XM

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Make it Last LONGER!

Heavy Body 3-IN-ONE Oil is MADE for electric refrigerators, washing machines, light electric motors! Heavier-bodied for heavier duty. Use it periodically to cut down repair bills. Try it!



HEAVY BODY



"3-IN-ONE" OIL

The Navy's Tools of War

(Continued from page 13)

which follows the target and transmits the data electrically to a plotting room below decks, where complex instruments evaluate all variables, mostly automatically, and transmit them electrically to the turrets. With this system, it is not necessary for the men at the guns to see the enemy ship at all.

The heaviest U. S. Naval anti-aircraft gun is the 5-inch. With its accurate and rugged fire control system, it has been proven by battle results to be the best in the world, for rapidity and accuracy of fire and effectiveness of ammunition. Its high explosive shell, burst by a time fuse, takes good care of any horizontal bombers which come low enough for accurate bombing, and helps in the defense against dive bombers, torpedo planes, and strafers.

But the 40-millimeter and 20-millimeter are the better guns for infighting. Both use explosive ammunition, but with sensitive contact fuses. The 40 is mounted in twin and four-barreled mounts, the 20 in singles, and both are plastered all over the topsides of our ships.

I can't tell you the exact number of these guns a particular ship carries, but I am certain you would be astonished if I did. Together with the powerful 5-inch batteries, the collection of these guns on each of our new battleships and carriers constitutes the heaviest concentration of anti-aircraft guns in such a limited space found anywhere in the world. The new cruisers, destroyers, escort vessels, PT boats, subchasers, tenders, repair ships, transports, and even cargo ships, have powerful batteries which really knock planes down.

I don't want to give the impression that everything we have in Naval ordnance is perfect, and that production has always been up to requirements. When you must do all your designing and testing in time of peace, it would be a miracle if everything came through the acid test of battle with flying colors. And when you consider how late this country really got down to the business of arming, it's not surprising that we have not always had all we wanted of everything.

But, taking all types of Naval ordnance together, we do not have to take our hats off to any other Navy, for either quality or quantity.

We have made a most promising start; and we will continue to give the ships and planes of our Fleet the best naval ordnance in the world, so that they can give the Fleets of the Axis their half of the ocean—the bottom half.

THE *HOW AND WHY* OF

DATA ON WILLIAMS' CUTTING-OFF TOOL HOLDERS (Data Sheet No. 12)

WILLIAMS

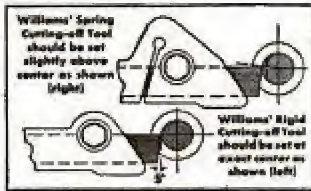
DROP-FORGED TOOLS



With Williams' Spring Cutting-Off Tool Holder, feed can be applied automatically leaving operator free to watch and thoroughly lubricate the work.

Williams' Spring Cutting-Off Tool Holder makes comparatively simple a lathe operation normally one of the most difficult. Several advantages result from the "goose-neck" design of this Holder which automatically provides relief from any sudden or excess pressure on the cutter blade. Even an inexperienced operator can cut off work considerably out-of-round without chatter, "climbing" or damage to either tool or work. The shock-absorbing qualities of this Spring Head, likewise, tend to protect lathe bearings and journals and will definitely improve the quality of work done on old and "loose"

lathes. Only with this type of Spring Holder can the automatic cross feed be used for cutting-off operations.



In setting-up, the *spring* cutting-off tool should be set slightly above center. A *rigid* cutting-off tool, however, should always be set on exact center. See drawing at lower left. Cutters may be sharpened by grinding the end of the blade . . . usually to an angle of 5°. The sides of Williams' blades never need to be reground since they have sufficient taper throughout their length to provide side clearance. The work should be flooded with oil when cutting off steel. No lubricant is necessary with cast iron or non-ferrous metals.

Below are illustrated the two types of Williams' Cutting-Off Tool Holders. The rigid Holder accommodates either a cutting-off or side blade without any adjustment. Its cutting-off blade is interchangeable with Williams' Spring Holder. Both these types of Williams' Holders employ a positive cam lock to hold their blades in place, which is both quick-acting and rugged.

WILLIAMS' SPRING CUTTING-OFF HOLDER



Straight Shank Pattern. Also made with Right Hand Offset shank.

WILLIAMS' CUTTING-OFF & SIDE-TOOL HOLDER

Left Hand offset Pattern. Also made with Right Hand Offset and straight shank.



FREE DATA SHEETS

J. H. WILLIAMS & CO., BUFFALO 7, N. Y.
ON USE OF SHOP AND HAND TOOLS

Your name and address in the margin below will bring 12 Tool Holder Data Sheets (punched for 3-ring binder) and a list of our complete Data Sheet series. Mail to above address, Dept. PM-4.

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STERLING

Every pipe produced from genuine imported Mediterranean briar of pre-war quality, and shaped by the skilled hands of master craftsmen to be "A thing of beauty and a (smoking) joy forever". Sterling Silver band; solid rubber bit. Every pipe numbered, and registered by LHS, as your guarantee of pipe perfection.

\$5

Smooth and
Antique
Finish.

Many hand-
some models.



"Perfection... in a Pipe"

LHS STERNCREST 14K

The custom craftsmen of LHS select the very choicest grains for these patrician pipes. They finish them by an exclusive process that brings out the full beauty of the briar,—circle them with a band of solid gold.

Truly, "Perfection—in a Pipe"

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L & H STERN, Inc., Stern Bldg., Brooklyn, N.Y.

Makers of the famous

LHS Ultra-fine \$10 Certified Purox \$3.50 Superfine Purox \$1.50

Put this in your
pipe and smoke it:

BUY WAR BONDS

'Shot in Wing' With Hypo Needle Cures Airplane Blisters



Hypodermic needles loaded with adhesive are used to puncture blisters that sometimes form in the cloth stretched over ailerons. The blister collapses and the adhesive seals the cloth to the wood form. This process, discovered by a worker at the Consolidated-Vultee aircraft plant, eliminates peeling off the blisters and applying patches. *Vultee Field, Calif.*

Suction Tubes to Remove Trash Proposed by City Engineer

Underground pneumatic tubes which would suck household wastes and ashes to central stations may supplant the garbage truck in the cities of the future, according to Morris M. Cohn, sanitary engineer for Schenectady, N. Y. Cohn explained that the "subway" system would eliminate the storage and handling of wastes and their surface collection. It would consist of a network of pneumatic ducts under the streets, with a connection in every home, store and industry. An air-lock chamber would permit the property owner to discharge ground-up wastes into the city's refuse "veins," from whence they would be sucked to an incinerator.

❑ In 1943 four million fewer automobiles were registered than in 1941, the peak year, respective figures being 25.5 million and 29.5 million cars.



THERE'S BEEN A BIG CHANGE

ONE REASON why moderns wear fewer clothes is because they must move faster than folks did in the old days. The tempo of things has changed.

But changes haven't all been a matter of *subtraction*. In the case of tapered roller bearings, a new, faster-moving age called for *addition*—addition of rollers to stand heavier loads and shocks. Tyson Heavy-Duty Bearings answer that need.

Tyson actually added *thirty percent more rollers*, on the average, size for size! This single improvement has virtually doubled bearing life for Tyson users. For every heavy-duty job, Tyson "All-Rolls" Bearings are the most advanced . . . toughest . . . longest lived.

* * *

The big name in bearings today is . . . TYSON!



TYSON BEARING CORPORATION, MASSILLON, OHIO

COUNT THE ROLLS - THE ROLLS COUNT

Tyson
TODAY'S HEAVY-DUTY BEARING



★ LET'S ALL BACK THE ATTACK ★

Now **ONE** in Name

**MILLERS FALLS
TOOLS**

SINCE
1868

**GOODSELL
PRATT**
1500 GOOD TOOLS



THE QUALITY which has always been symbolized by the Goodsell-Pratt trademark lives on under the Millers Falls name. One in quality for generations — one in production and management since 1931 — Goodsell-Pratt precision tools now carry the company name — Millers Falls. Only the trade-name is changed.

So when you buy, insist on the name Millers Falls.

**MILLERS FALLS
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**MILLERS FALLS
COMPANY**

**Greenfield, Mass.
U.S.A.**

77816
"Salt Shaker" Selects Right Rivet
By Twist of Rotating Top



Selection of the right size rivet from a number of sizes is made easy by use of a "salt shaker" dispenser, employed on aircraft construction in the Detroit plant of the Murray Corporation. Several cylindrical compartments hold the rivets separately, graded according to size. A rotating top with a hole through which the rivets pour like grains of salt is turned until the right compartment is reached. The compartments are labeled to indicate the size of the rivets in each. *Detroit, Mich.*

**Anti-Typhus "Dust" for Vermin
Is Effective for a Month**

Effective protection against typhus is offered by a chemical agent, DDT (dichlorodiphenyl-trichloro-ethane), just adopted by the War Department. A single application of it dusted on clothing gives protection from disease-carrying vermin for one month. It is considered such an effective insecticide that the army recently flew the first 500-pound cargo produced at a DuPont plant to an overseas base. DDT was largely used as a moth repellent and plant lice control until recently, when the United States Department of Agriculture announced it had successfully tested it against body lice.

LEADERS DO THINGS FIRST

Leadership rests upon the ability to foresee, to develop, and to achieve—first. ★ On that critical basis, weigh the position of the Allison engine. ★ Allison built the first aircraft engine in the world to receive official military rating of more than 1,000 horsepower. ★ Allison manufactured the first airplane engine in all the world to weigh less than one pound per horsepower. ★ These are only two of the thirteen major advances in aircraft - powering credited to Allison. ★ Leadership is earned by achievements at the forefront of development.

Every Sunday Afternoon
GENERAL MOTORS SYMPHONY
OF THE AIR—NBC Network

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF



POWERED BY ALLISON:

P-38—Lightning • P-39—Aircobra • P-40—Warhawk • A-36 and P-51—Mustang

KEEP AMERICA STRONG
BUY WAR BONDS

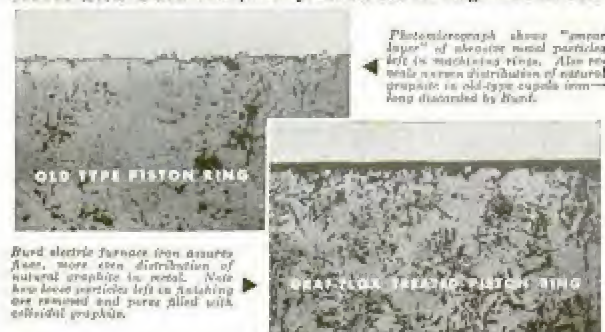
APRIL, 1944

167

PHOTOS SEE ALL-TELL ALL

Prove What "Graf-Flox" Does

Scientific photography reveals why Burd "Graf-Flox" Piston Rings save money for car owners. Laboratory microphotos show (1) why Burd discarded old-type cupola iron in favor of electric furnace iron because of its finer, more uniform distribution of natural graphite (2) how abrasive metal particles left in machining are completely removed, and (3) how open pores of metal are sealed with deeply-penetrating, firmly-fixed colloidal graphite. That's why Burd "Graf-Flox" Piston Rings are self-lubricating, self-sealing, and non-scoring—why they reduce friction and wear, add years of life to rings and motors.



Photomicrograph shows "spongy layer" of abrasive metal particles left in machining rings. Also reveals uneven distribution of natural graphite in old-type cupola iron—being discarded by Burd.

Burd electric furnace iron assures finer, more even distribution of natural graphite in metal. Note how loose particles left in machining are removed and pores filled with colloidal graphite.

BURD PISTON RING CO., Dept. PM, Rockford, Ill.

THIS COUPON BRINGS 2 FREE BOOKS

Burd Piston Ring Co., Dept. PM, Rockford, Illinois.
Gentlemen:
Please send me your Handy Hand Book on how to keep my car in good working order. Also Victory Car Economy Record Book to keep mileage costs and gas coupons safely.

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Better-Built Chests for the more exacting mechanics. Free catalog for machinists and tool-makers.
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Say you saw it in Popular Mechanics!

BRIGHTSTAR FLASHLIGHTS and BATTERIES

NOW SERVING OUR MEN ON EVERY FRONT!

BRIGHT STAR BATTERIES

WHEN THE WAR IS OVER THEY'LL SERVE AT HOME AGAIN!

BRIGHT STAR BATTERY CO., CLIFTON, NEW JERSEY

STOP LEAKS IN BASEMENT WALLS, FLOORS



Stop those leaks! End that seepage through cracks in basement walls and floors. Use **STOP-IT**—spacing, quick-setting, water-proof material. INSTANTLY seals dripping cracks and openings. For interior and exterior use.

EASY TO USE Simply mix with water and apply on cracks. Sets hard and permanent. At amazing low cost, you can turn that damp, musty basement into a delightful playroom. Get **STOP-IT** at your dealer or write direct.

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Send for free "Household Hints in War-Time." Tells how to save money, conserve food, clothing, fuel.

CRAFTSMEN—STOP RUST WITH

FIENDOIL

Protect tools, clean and coat them with this anti-corrosive favored for years by gun and tackle users. Get it now at your Sports or Hardware Store.

2 oz. Bottle—35¢

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★ go thousands of **HULL COM-PASSES**. Wartime improvements will make available an even finer instrument for the Road to Vacationland—after Victory.

HULL MFG. CO.

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ANYONE CAN DO THIS IF THEY HAVE OUR CHART. Blue Print 27"x38" shows how to find length of any rafter; find any angle in degrees, frame any polygon 3 to 16 sides, read board foot and brace tables, octagon scale, rafter tables and many other uses. Can be scaled down for model work as well as full scale framing. Also Chart changing pitches to degrees for use with Radial Saws. Send 50c in Coin or M. O. No Checks or Stamps. **MASON & PARRISH ENGINEERS, 2106-B N. Burdick St., Dept. D, Kalamazoo, Mich.**

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SHAW and "Peppy-Pol" GARDEN TRACTORS

• 1 to 9 H.P. Circulars on request. War limits production—We supply repairs for all SHAW Tractors sold in our 40 years in business.

BUILD YOUR OWN RIDING TRACTOR—"WAR HORSE"

using old auto parts, powered by 2 H.P. or larger air-cooled engine; or walking type Garden Tractor 1/2 to 3 H.P. as shown; or convert truck or auto into Farm Tractor. Each will plow, cultivate. Plans for building, in one day, any one of above, postpaid for \$1.00 (state which wanted) or all 3 for \$2.00. Money Back Guarantee!



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"PLENTY RUGGED", say our fighting men, to sum up the tough jobs . . . to patly describe any grim task from long, forced march to furious battle action.

Rugged too are the assignments that Evinrudes are capably handling in every part of the world—from busy home ports to beachheads on distant fighting fronts.

Powering lighters, ferries, tenders, work boats . . . many Evinrudes are rolling up operating records equal to several lifetimes of ordinary duty.

On assault craft, swift and powerful "fighting" Evinrudes have proved their

stamina on many fronts. Evinrudes serve with England's famed Commandos. Great Evinrude "fours," specially developed for the purpose, drive many of the Army's speedy Storm Boats.

Motors for such service . . . motors of many types for our fighting forces . . . are the only kind we are building now. Some day new peacetime Evinrudes will follow down the production line. You can be sure they will be tops for "rugged" service . . . and that in every other characteristic, they will be sheer pleasure to own!

EVINRUDE MOTORS, Milwaukee, Wisconsin



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BUY MORE WAR BONDS

EVINRUDE

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make an OLD MAN
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• Maybe you're missing something, mister... maybe you could end that "old man" feeling this simple, scientific way... with a Bauer & Black self-adjusting Suspensory. Men everywhere in all walks of life, active or quiet, heavy or light... say the firm, comfortable, flexible support of a Suspensory makes them feel years younger... less tired... all the time.

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Please send me your booklet about Suspensories.

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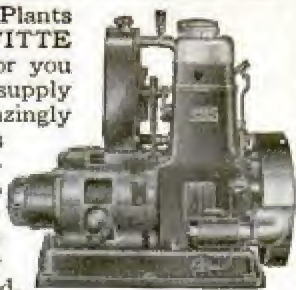
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My Occupation is ☐ Active ☐ Not Active

LOOK for New Post-War WITTE DIESELECTRIC PLANTS

The finest Dieselectric Plants ever to carry the WITTE name will be ready for you after victory... to supply power and light at amazingly low cost. Over 74 years manufacturing experience contributes to their reliability. Today, WITTE Units are serving the victory cause all over the world.



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LARGEST BUILDER OF SMALL DIESELS
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SAVE THAT CHAIR!

Broken furniture can often be repaired permanently, quickly with **PLASTIC WOOD**! Handles like putty; hardens into wood. At Paint, Hardware and 10¢ Stores.



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Modernize Your Gun! Improve Your Score!

Most durable grips made. Positively unbreakable! For Colt, Smith & Wesson, Hi-Standard, Origines, Luger & Mausers in a wide choice of beautiful designs in Ivory, pearl, walnut, onyx, etc. Low prices. FREE CATALOG. Dealers Wanted.

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**\$20.00
COMPLETE**



ENGINES IN STOCK

The G. H. Q. miniature gasoline engine that really operates is still available. Over 100,000 sold to date. 1/5 H.P. Complete with flywheel and propeller, fuel, 15 accessories and full instructions. Fully bench tested and ready to run. For boats, planes, midget cars, etc. Send only \$1.00—Shipped Collect C.O.D. same day. Send 25c for illustrated Catalog of hundreds of hobby items.

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6 H.P.
EASY to MOVE**



Fells trees. Saws big logs, small logs, limbs. Pulley for belt work. Easy to handle, weighs less than lower powered units. FULLY GUARANTEED. Cash in on fuel shortage. Turn wood lots into cash.

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Just attach to your radio (long, short wave) and enjoy reception free from distracting noises. Send-No-Money Pay Postman 60c plus postage or send 60c and we'll send postpaid. Return in 5 days for refund if not delighted.

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TO the hard of hearing men, women and children of America, a new world of happiness has been opened! At a cost which, for the first time, brings a fine type of hearing aid within reach of all, the new Zenith Radionic Hearing Aid is lifting the cloud of misunderstanding and missed opportunities from the lives of those who have suffered in silence.

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cover the enjoyment that comes when normal sounds are heard again.

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Note carefully the advantages which the new Zenith Radionic Hearing Aid now brings you—and we feel sure you will decide never to pay *more* and get *less* in a hearing aid. You will find it worth your while to wait a little longer, if necessary, until Zenith's precision production facilities can meet the needs of your community.

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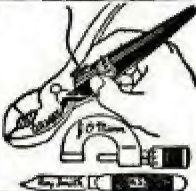
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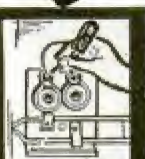


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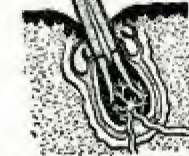
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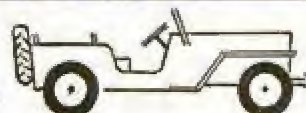
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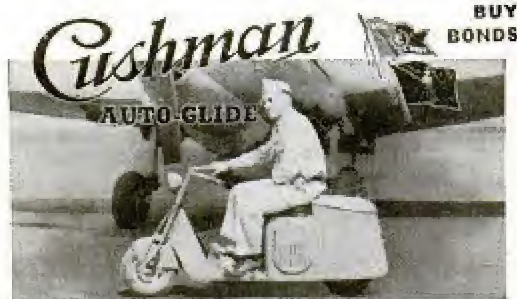
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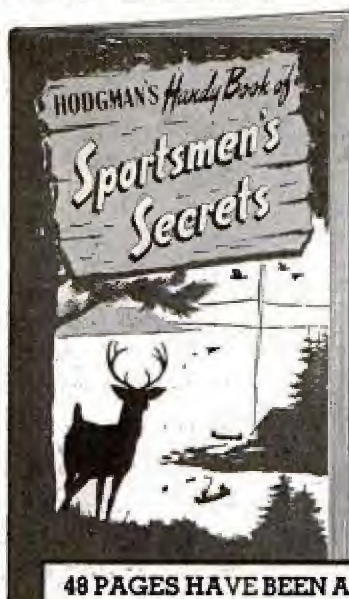
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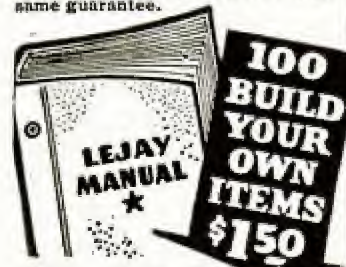
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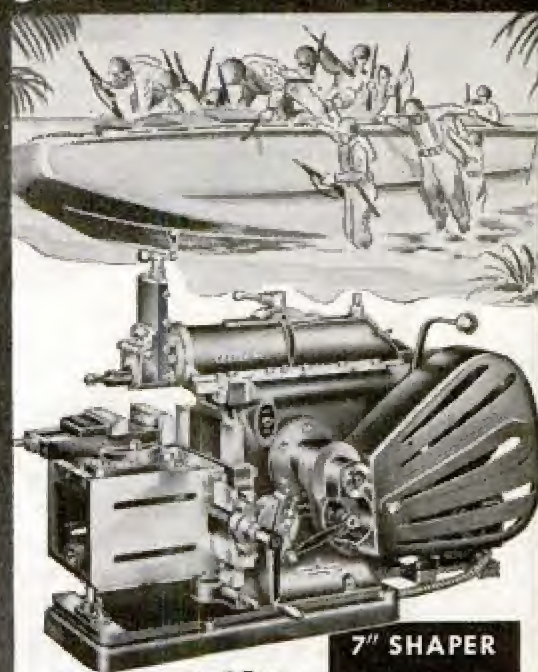
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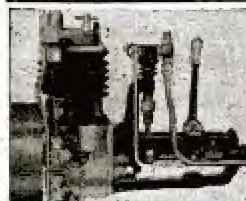
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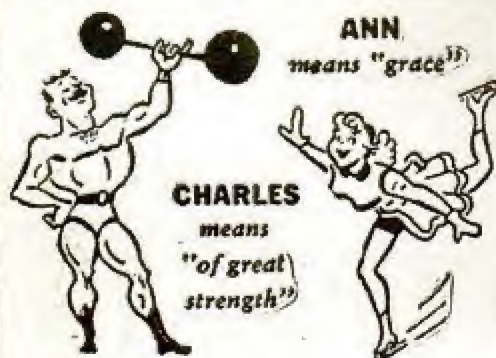
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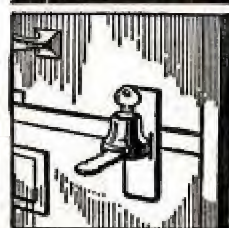
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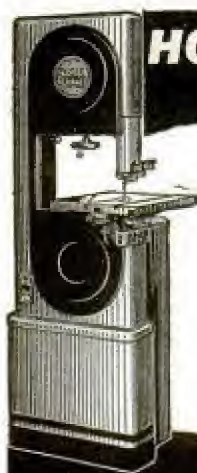
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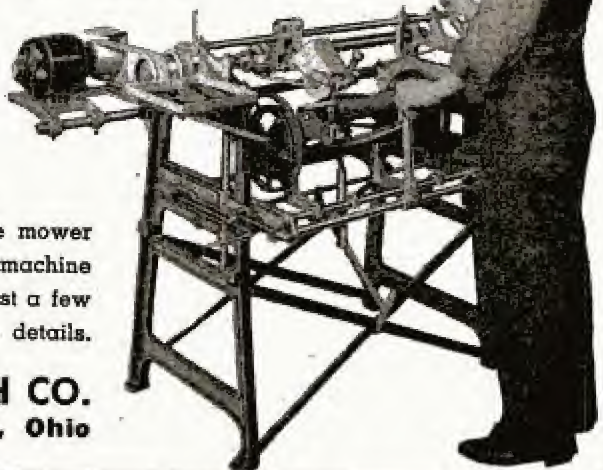
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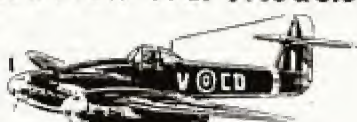
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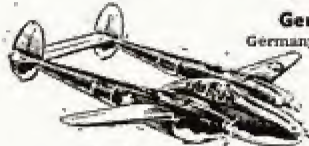
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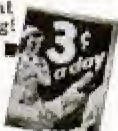
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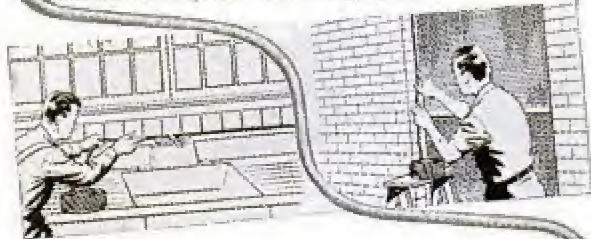
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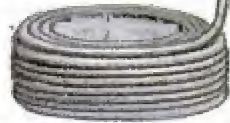
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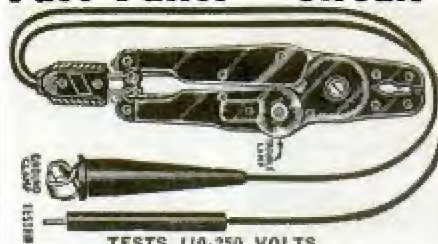
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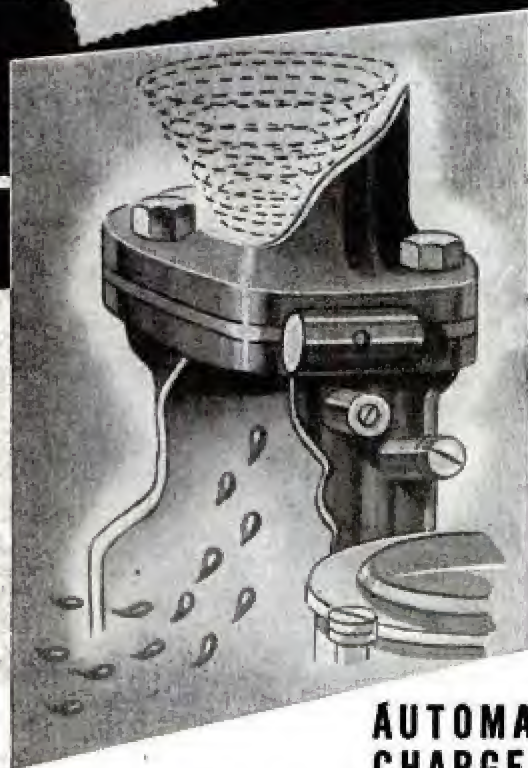


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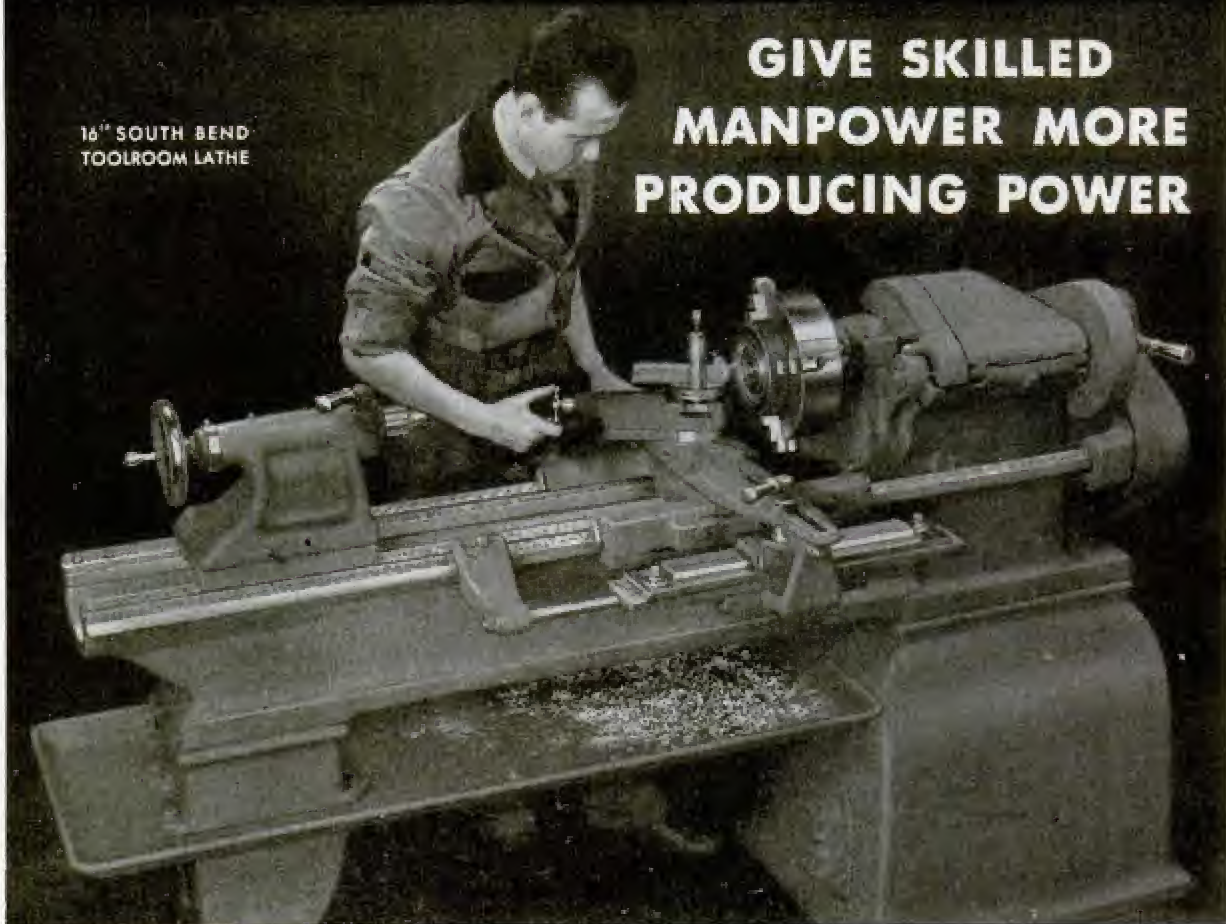
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INSIDE THE WAIST of this "Fort," everything is strictly business. Outside of "office hours"—that's when Camels come into the picture (see right). You'll find Camels extra mild, full-flavored, and fresh everywhere... CAMELS are packed to go round the world, to stay fresh anywhere!

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• They're the waist gunners of a Flying Fortress; and come Zeros or Messerschmitts, you'll find them at the two 50-calibre guns at the left. And after that B-17 has set her wheels down, you're apt to find them lighting up a Camel... for, as the gunner below at the right puts it: "Camels have a full, round flavor that says 'welcome' from the first puff. And I know from experience, they're extra mild."

First IN THE SERVICE

The favorite cigarette with men in the Army, the Navy, the Marines, and the Coast Guard is Camel.

(Based on actual sales records.)

CAMELS



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Camels
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Zone

R. J. Reynolds Tobacco Co., Winston-Salem, N. C.



BUY
WAR BONDS
STAMPS

If you haven't smoked a Camel recently, give them a try today. Compare them for taste... for your throat... for your "T-ZONE." On the basis of the experience of millions of smokers, we believe you will like the extra flavor... we believe your throat will confirm the findings of other Camel smokers.